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THE

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THE "EXPERT" ELECTRICAL ENGINEER.

IN a recent number of *Cassier's Magazine*, Mr. H. de B. Parsons treats of the subject of the "expert" electrical engineer from an American standpoint. After some analysis of the question from various points of view, he arrives ultimately at the conclusion that there undoubtedly is a niche in the pantheon of organised American industry for the professional expert, and that a genuine demand exists for men of good understanding to exercise the functions of adviser to the uninitiated buyer, and mentor to advocate and client in litigation in which technical issues play a part.

In England, the "expert" exists in a modified, but intensified form. With us he is called "consulting electrical engineer," and has attained to a high degree of specialisation. With rare exceptions he is not usually to be found playing a successful *rôle* both as "scientific witness" and buyer's adviser—probably because the stamp of man who appeals to the tutored intellect of judge and counsel, as the former, is not of the stuff which commends itself to the more impressionable mind of the man of commerce.

We have all, nowadays, learned to accept the doctrine of adaptation of means to ends in the cosmos so thoroughly, that we need not stop to inquire too curiously into the genesis of the modern consulting electrical engineer. We will admit that if in our time and place he is present in a certain form, it is roughly due to the simple fact that there is a demand for him in such form. Hence it is as idle to speculate upon the desirability of his presence, as for a man who is afflicted with, let us say, toothache, to endeavour to find comfort in the reflection that there was a time when the progenitors of the human race had no teeth, and that biologists assure us that that phase will recur again if only civilisation continues to retain in the modern *ménu* for a sufficient number of æons.

Hence the subject would not be matter of interest to practical men, were it not for the prevailing opinion within the ranks of the electrical industry, and of the profession itself, that the evolution of the species can be advantageously modified by forces within our control.

Of the "expert," in the sense of what is known among us as "scientific witness," and, with unconscious humour, defined in Scotland as "peculiar view-taker," it is unnecessary to speak. Litigation is of the destructive, and not constructive, side of electrical engineering; and without entering upon such questions as to whether a scientific witness should adopt the attitude of a special pleader or of a Rhadamanthus, which properly belong to the sphere of jurisprudence, we may confine ourselves to the cordial hope that, in the interests of the public as well as of the industry, a time will come when he will be no more required, because there shall be no more war; when the inventor shall lie down with the in-

fringer, and the wiring contractor with the fire office inspector.

But over the "expert," in the sense of "consulting electrical engineer," we may linger awhile with advantage; and it may at the offset be boldly asserted that this profession is not merely a necessity to the buying public, but contains within itself the germs of infinite advantage to the producing electrical industry.

The buyer of electrical apparatus, as of everything else, knows better what result he wishes to attain than about the means to attain it. Manufacturers have been known to plead that if the buyer would place himself unreservedly in their hands, they would help him out of his embarrassment, and save him a consulting engineer's fees into the bargain. But it is superfluous to point out that this course is not consistent with progressive development, even if any considerable number of buyers could be induced to adopt it. The employment of a duly qualified consulting engineer is the proper course to pursue, and this brings us to the root of the whole matter: What constitutes a duly qualified consulting engineer, and how can he be detected?

That there are an unduly large number of men in this country who annex the title, without possessing the attributes, of a consulting electrical engineer, is unfortunately notorious. A rose by any other name may smell as sweet, but by what virtue are the great buying public to know whether a man who styles himself "consulting electrical engineer" is the genuine article? and when he secures employment under false pretences, the injury to the electrical industry is grave, for reasons which will presently be apparent.

As between the public weal and that of the manufacturer, there is some conflict, it is to the interest of the former that invention and progressive development should go on steadily and unchecked; it is to the advantage of the latter as a class to minimise changes of designs and patterns, and to settle down to production of standard articles in quantity.

In the judicious reconciliation between these opposites we find the highest vocation and privilege of the consulting engineer—to educate public taste into progressive improving channels, and in doing so, to hold the balance evenly between the buyer, for whom it is his duty to procure the most efficient means the industry can afford of carrying out the requirements, and the producer, the electrical industry, for which it is his duty to ensure a fair price and fair conditions. The consulting engineer is the man at whose hands the demands of the public become incarnate; the bell-wether whom buyer and producer alike should feel it to their advantage to follow.

He thus requires to possess qualifications of a high order, qualities of experience and judgment, as well as mere technical knowledge. Can it be said that a satisfactory proportion of the men whose office door-plates bear the legend "Consulting Electrical Engineer," comply with the specification of requirements above laid down? We trow not.

That there are men, so calling themselves, who hold the balance between the public and the electrical producer with wisdom, men to whom the industry owes, and is accumulating a heavy debt of gratitude, is fortunately true; but this is not because they call themselves, but are, consulting electrical engineers.

On the other hand, the electrical producing industry in this country has been a victim of much unnecessary hardship, by reason of the uncertain lights on which it has been dependent for guidance. Much of its unsatisfactory position at the present time is no doubt due to purely internal causes of which the chief is the reckless competition existing between its members, and the total want hitherto of an understanding among them upon those matters in which their interests are common, as opposed to outside influences. But no inconsiderable element of the spectacle which this industry, pregnant as it is with greater hope and advantage to mankind than perhaps any that the world has seen, presents of want of unity and disappointing commercial results, must be sought in the dance of unnecessary trial and error, under inequitable conditions, through which it has been led by the buying public, guided largely by those who, doubtless in all good faith, but with want of understanding, have essayed to point the more excellent way.

The cure for this condition of things would seem to lie partly in the hands of the buying public, and partly at the door of the consulting profession. So far as the public are concerned, they should have better security that the men who dub themselves consulting electrical engineers are so in fact. As regards the inexperienced members of the consulting profession, it may be hoped that they will waken to a keener sense of the obligations and responsibilities of their calling.

By what means are the public to derive increased security? Is it not at any rate desirable that the title, "Consulting Electrical Engineer," should necessarily connote such a definite training, as to have afforded the man who employs it the opportunity of acquiring knowledge of his profession.

There is at present nothing to prevent the rawest youth who emerges from a technical school or electrical workshop from calling himself consulting engineer, and posing before the public as a man who has useful advice to offer to the buyer. This should not be. When a man inscribes C.E. after his name, it has a more or less definite connotation as to his training and qualifications. It does not imply that he is a Brunel, but it does exclude the possibility of his opacity to every ray of understanding as to his duties and obligations midway been buyer and seller.

A similar tacit qualifying standard is required for the sister branch of electrical engineering. It may be suggested that membership of the Institution of Electrical Engineers should be accepted as such a standard. This would certainly be a step in the right direction, but short of the mark; because while the suffix M.I.C.E. means that a man has had the training of a civil engineer, and M.D. ensures previous passage through a qualifying mill in medicine, that of M.I.E.E. does not necessarily involve the idea that its user is an electrical engineer.

Something more than this is wanted. Dr. Johnson said that something more is always wanted in such cases—that uniquely rare commodity, common sense. But the millennium is a picturesque prospect on which one cannot reckon. The difficulties in the way of establishing a formal qualifying standard are great; but in the meantime something may be done by clear appreciation of the stage we have reached, and the bourne towards which our steps should be directed. What is wanted is the growth of popular feeling upon the subject—the formation of one of those unwritten statutes of society, which are none the less binding because implied and not explicit. If the buying public and the industry were to demand a higher standard for the man who

styles himself "Consulting Electrical Engineer," not only would both be decided gainers, but wisdom would be justified of her children, and the profession itself advance in prestige, public estimation, and profit.

And it is because the consulting electrical engineering profession has so many well wishers—how can it be otherwise?—among the electrical producing industry, who recognise in it at once a source for the evolution of electrical discovery and improvement, and a pendulum by which the speed of subsequent commercial development can be regulated in the interests of producer and consumer, that this article has been penned.

A Difficulty in the Way of the Industrial Employment of Aluminium.

It could scarcely have been expected that so "young" a metal as aluminium could jump into prominence so quickly and yet attain perfection. The fault is not inherent to the metal itself but rather to the weaknesses in its method of preparation. The fact is, that commercial aluminium is a substance which exhibits a considerable range of composition: it is rarely pure, and it is seldom that samples drawn from different bulks exhibit the same degree of purity. Moissan, whose researches upon the metals generally have been attracting so much attention during the past few years, has shown that the metal often contains nitrogen and carbon, two ingredients which obviously affect its properties very materially. In a recent paper read by him before the Paris Academy of Sciences, he stated that commercial aluminium sometimes contains sodium, and further, that the presence of this ingredient is an important factor in the preservation of the metal. Moissan in his paper, which may be consulted in the *Comptes Rendus*, Vol. 121, p. 794, enters minutely into a description of the chemical tests by means of which he recognised the presence of and determined the amount of this metallic ingredient. We need not, however, follow him through with these details, but may note that in an old sample of aluminium as much as 0·4 per cent. of sodium was found, whilst the amount in more recent samples it varied from 0·1 to 0·4 per cent. This percentage seems a very small one, but to those who are at all familiar with the important influences which the presence of mere traces of impurities in metals can exercise upon their physical properties, these amounts will by no means appear to be insignificant. Moreover, Moissan states that when aluminium contains sodium it is even attacked by cold water, and that the decomposition appears to become more rapid after a time. The non-homogeneity of aluminium seriously affects the preservation when it is exposed to the action of liquids. The decomposition commences in the form of little spots of hydrated alumina upon the surface, and these are frequently formed round little centres of carbon, the latter itself a frequent impurity. After stating that an alloy containing 6 per cent. of tin with aluminium very free from sodium, stood a prolonged immersion in the water of the Seine without suffering serious corrosion, Moissan brings his paper to a conclusion urging upon all who are seeking to use this metal industrially the importance of always employing it by itself in the purest possible form, free from carbon, nitrogen, or sodium, and pointing out that aluminium has a great tendency to form an electric couple with any other metal.

The Fate of the Energy of a Battery during Electrolysis.

This has always been an attractive subject for study, and there has been considerable research made upon it recently. Amongst those who have endeavoured to explore this somewhat obscure subject is Hans Jahn. He has been considering the matter from the point of view of the direct measurement of the heat evolved in the battery—we believe a new aspect of investigation in this connection. From his measurements (*vide Zeitschrift für Physikalische Chemie*, xviii., p. 399), and the calculation of that developed in the circuit he has obtained the total heat development per unit current (*a*) without and (*b*) with, polarisation. The difference in the energy necessary for the decomposition of the milligram equivalent was obtained by Jahn, and he deduces the value of the polarisation. The last two values are given for zero Centigrade in the accompanying table under the headings, *w* and *p*, *dp/dt* being the heat coefficient, in volts, of the polarisation between 0° and 40° Centigrade, at which temperatures the experiments were carried out. On inspection of the table it is seen that the values for the polarisation are, in all cases, very much higher than those obtained by other methods which are recognised in practice. The difference between the heat values thus obtained, and the heat of formation of the electrolyte must equal the heat produced in the decomposition cell owing to the Peltier effect. The quantities of heat produced at the two differ, and from the differences actually obtained the Peltier effect is determined by Jahn in the case of copper / copper sulphate, zinc / zinc sulphate and cadmium / cadmium sulphate junctions, the values so derived agreeing very well with those calculated from the thermo-electromotive forces of the junctions. The cathodic and also the anodic polarisation is also calculated, the values for the latter being somewhat greater for sulphate than for nitrate. The heat of ionisation, as is obvious, was readily obtained, and it appears that the values agree very satisfactorily with the heats of solution of the metals in dilute nitric or hydrochloric acids. The table referred to above is as follows:—

	w.	*p*.	*dp/dt*.
Copper sulphate ...	79·86 ...	1·756 ...	— 0·00508
Zinc „ ...	126·88 ...	2·790 ...	— 0·00524
Cadmium „ ...	110·15 ...	2·444 ...	— 0·00315
Copper nitrate ...	81·31 ...	1·788 ...	— 0·00465
Lead „ ...	— ...	2·267 ...	— 0·00460
Silver „ ...	— ...	1·330 ...	— 0·00382

The last two values, namely for lead and silver nitrates, were calculated from those of copper nitrate by means of the known E.M.F. of Cu — Ag and Cu — Pb cells.

The Annual Picnic of the B.A.

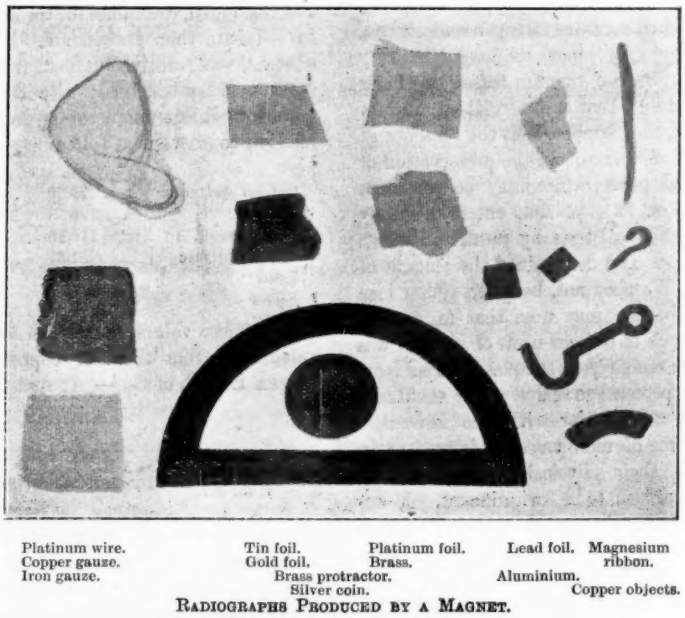
Those who, having a leaning towards matters electrical, are wont to take their annual holiday contemporaneously and topographically with the yearly meeting of the British Association, are, now that the winter is over and the smell of spring-tide is in their nostrils, resuscitating the agitation for a new electrical section of the Association. We all remember the plaint of an esteemed contemporary some months ago about Section A, that "it is a common occurrence when other sections are out at play for this (the hardest worked of all) branch of the Association to divide itself into two or even three sub-sections, each with its own lengthy programme of papers." The plaint is undoubtedly well founded, though the argument is by no means so commendable, for we are not amongst those who think well of what the French term the *vulgarisation générale* of scientific matters which are really business matters. It is to be hoped, however, that the new electrical section will be created, for it will permit of a wholesome weeding out of the picnic people who only make the B.A. meeting an excuse for junketing; and will ensure quieter meetings free from aimless interruptions, somnolence and wanderings-about, during which good work may be done and profitable discussions pursued. Such weeding out, which will largely, we believe, be accomplished by sub-division of sections, may have the desirable effect of pleasing all parties, the earnest ones will have a freer hand and so will the picnickers.

MAGNETOGRAPHS MADE BY RADIATIONS FROM THE POLES OF A MAGNET.*

By Prof. JOHN S. McKAY.

If a paramagnetic substance be placed upon the sensitive film of an ordinary photographic plate and the poles of a magnet, either a permanent or an electro-magnet, be brought near to the other side of the plate and left for a time, the plate, when developed, will show a clearly defined image of the object. Positives made from such plates will give in shadow the outlines of any object used as armature. Thus may be obtained clearly defined silhouettes of a key, a wire gauge, a pair of pliers, or any iron or steel implement used as armature.

If the plate be placed with its sensitive side facing the poles of the magnet and a disc of iron nearly as large as the plate be placed on the opposite side in the position of armature, "shadowgraphs" of any non-magnetic or diamagnetic bodies placed on the other side, between the plate and the poles of the magnet, will be produced upon the plate. The shadow pictures produced by either of these methods are as clear and distinct as those produced by Röntgen rays. I have obtained dark shadows with a compound steel magnet weighing little more than a pound. If strong electro-magnets are used, the poles may be separated several inches from the plate. With an electromagnet capable of lifting 100 lbs. or more, I have made a "magnetograph" through a block of wood 2 inches in diameter. The object whose image is to be impressed upon the plate must be in contact with the sensitive film; a thin sheet of mica or paper seems to prevent the action, or at least to decrease the effect more than the removing of the poles several inches. The best results seem to be secured by suspending the magnet in a vertical position, so that the plate and the keeper will be held up against the force of gravity, as shown in fig. 1, but that arrangement is not essential to success. In experimenting with electro-magnets the objects were placed on the plate, and the plate was wrapped in several folds of black paper in the dark room. The plate was thus very perfectly protected from light throughout the experiment.



Radiographs Produced by a Magnet.

The image shown was produced with the apparatus arranged as shown in fig. 1.

In the case of an electro-magnet, varying the current by means of a rheostat or frequently making and breaking the circuit seems to facilitate the formation of the images. The time of exposure does not seem to be a matter of great importance, although the plate is evidently darkened more and the contrast increased by a long exposure. I have, however, obtained as clear an image in five minutes as with the same magnet after an exposure of ten hours. It would seem that the action is largely due to the approach or removal of the armature or to the change of current strength. I judge this to be true for the reason that the slightest change in the position of the object immediately after being placed in the field produces a double shadow of nearly equal intensity. In one case a key was used as an armature. In suspending the magnet in the dark closet the plate and key fell from the poles. They were immediately replaced in what was supposed to be the original position. When the plate was developed ten hours later, it showed two images of the key of nearly the same intensity, overlapping, with ends

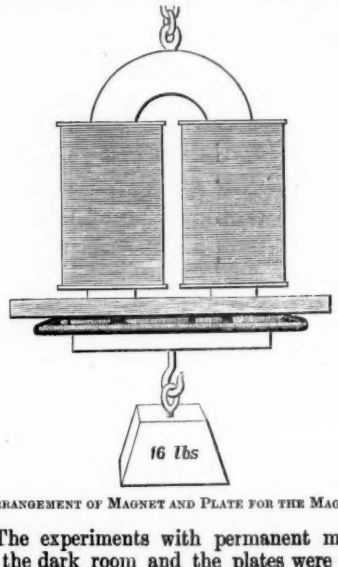


Fig. 1.—Arrangement of Magnet and Plate for the Magnetograph.

reversed. The experiments with permanent magnets were all made in the dark room and the plates were not covered. I used the Cramer Crown plates and eikonogen developer.

The results of these experiments are given with the hope that they may prove interesting and perhaps helpful to those who are trying to solve the great Röntgen conundrum. They seem to indicate that the ether in the field of a magnet is in a state of permanent stress, perhaps due to ether vortices, and that any change in magnetic force caused by motion of the armature or variation of current strength produces a change in the degree of stress, and thus originates ether waves capable of affecting the ordinary photographic plate. There does not seem to be any difference in the radiations from the two poles, since the plate is equally darkened on all sides except where protected by intervening objects. Conductors seem to be the most opaque to these magnetic radiations, possibly by converting the energy of the waves into eddy or Foucault currents. It is not clear why the armature should protect the plate beneath it. One would naturally expect that there it would be affected the most.

Perhaps the shadow pictures produced by long exposure to sunlight, and which some think to be a Röntgen effect, may be caused by magnetic waves from the sun. And may not the Röntgen rays themselves be something analogous to these magnetic rays? May not the Röntgen effects be due to the magnetic component of a Hertz wave?

* *Scientific American.*

DYNAMO REGULATION.

There is probably no detail of electrical engineering on which more brain energy has been spent than the regulation of the output of a dynamo. Hundreds of devices have been invented and re-invented for this purpose. Many of these,

by a process of natural selection, have arrived at the scrap-heap of useless inventions. A small number, which can easily be reckoned up on the ten fingers, have stood the test of practical experience.

In the current number of *Electric Power*, N.Y., Mr. Joseph Sachs has collected and classified the most important systems of dynamo regulation. Obviously there are two principal methods of regulating a dynamo—first, for series distribution, when the current has to be kept constant, and secondly for parallel distribution of electricity, when the pressure has to be kept constant. In both cases it is the electromotive force of the dynamo which has to be regulated, and the systems of regulation are classified in five groups as follows :—

1. Variation of the magnetic flux in the armature—(*a*) By variation of the exciting current. Examples : Shunt dynamos with resistance in the shunt circuit, variable by means of a rheostat controlled either by hand or automatically ; compound wound dynamos ; separately excited dynamos or alternators ; series dynamos with a variable shunt to the exciting coils. (*b*) By variation of the number of turns of the field coils. Example : Series dynamo. This method is inapplicable to a shunt machine, as the excitation in this case is independent of the number of turns. (*c*) By variation of the reluctance of the magnetic circuit. Examples : Movable pole pieces. Armature movable in the direction of its axis. None of the examples of this method of regulation referred to by Mr. Sachs have stood the test of practical experience.

2. Variation of the rate of traversing magnetic flux. This method is in general use in central station work in this country, where it is the practice to run a number of steam dynamos in parallel, and to regulate by variation of speed.

3. Variation of the number of conductors traversing the magnetic flux. This method, Mr. Sachs points out, is quite impossible in practice, and as far as regards one particular machine, this view is no doubt correct. The general central station practice, however, is to run fewer or more units according to the load. The units are connected with the bus bars or with feeders according to requirements. Where alternators are not run in parallel, the regulation is effected by connecting the different circuits to different units according to the load. In either case there is a variation in the number of active conductors.

4. Shifting the brushes on the commutator. Example : Series dynamo for arc lighting.

As examples more theoretical than practical, of class 1, there are compound winding for constant current, and regulation by means of a magnetic shunt.

One important method of regulation for constant current is briefly alluded to. This consists in making use of the armature reaction. An increase in the current of a series dynamo produces an increase in the excitation and might therefore be expected to produce an increase in the magnetic flux, and a corresponding increase in the electromotive force. If, however, the iron of the field-magnets is excited to a high induction, an increase of exciting current produces only an inconsiderable increase of flux. The armature reaction acting in opposition to the field excitation has the effect of driving the flux out of the armature and increasing the magnetic leakage. The result is, that the increase of armature current beyond a certain amount produces a decrease of electromotive force. This principle is adopted in several arc light dynamos, and acts as a valuable safeguard against a dangerous increase of current. It is, however, imperfect, and is generally supplemented by one or other of the methods of regulation which have been alluded to.

Mr. Sachs has confined himself to the question of the regulation of single dynamos, and assumes that either the current or the pressure of the dynamo has to be kept constant. In a system of parallel distribution, the central station engineer has to regulate the pressure of his units at the station so as to keep the pressure constant over an extended area. He has to allow for fall of pressure in mains and feeders, and this will be subject to variation whenever there is a change in the load. Hence the regulation of the dynamos has to be carried out so as to vary the pressure with the load, rather than to keep it constant. Among systems of distribution of electricity at constant pressure may be mentioned regulation by means of storage batteries by additional feeders supplied at a higher pressure, equalising dynamos or transformers in connection with a three-wire system. When the supply is alternating the necessary increase of pressure for feeders is often obtained by inserting a transformer in series with a feeder. Regulation at sub-stations is effected by varying the number of transformers in use.

ON SECONDARY BATTERIES FOR ELECTRICAL LOCOMOTION.

By DESMOND G. FITZ-GERALD.

(*Continued from page* 464.)

On a line of tramway, or in the system of an automotric carriage company, the economy in annual expenditure corresponding to a diminution of one ton in the weight of the secondary batteries in use is very considerable ; although it must be remembered that this may have to be balanced against an annual expenditure due to a diminished durability of the batteries.

If C = the weight of vehicle and passengers in tons.
A = the weight of accumulator in tons.
$M = C + A$ = the rolling load in tons.
L = the distance in miles travelled in t minutes,

and $n = \frac{2{,}240}{f}$ = the reciprocal of the mean tractive force per ton.

Then $\frac{L}{t}$ = speed in miles per minute, and the mean horse-power expended in traction will be

$$\text{H.P.} = \frac{M\,L \times 358}{n\,t}.$$

If we agree to term *useless horse-power* that expended in conveying the secondary battery, the useful horse-power is :

$$h.p. = \frac{M\,L \times 358}{n\,t} \times \frac{C}{A + C} = \frac{(M - A)\,L \times 358}{n\,t};$$

and the ratio of *useful* to *total* horse-power is

$$\frac{h.p.}{\text{H.P.}} = \frac{C}{C + A}.$$

On a certain tramline with easy gradients and curves, the average tractive force (f) per ton, at the speed of 7 miles per hour, was about 52 lbs. (Reckenzaun). A diminution of one ton in the weight of secondary battery would, under these conditions, result in a saving of

$$\frac{7 \times 358}{60 \times 43} = 1 \text{ horse-power (nearly)},$$

applied at the driving wheels. This power cannot be estimated at more than 33 per cent. of that generated by the steam engine used for charging the secondary battery ; the initial expenditure thus being three horse-power. Taking the cost of a steam horse-power hour at two-thirds of a penny, and reckoning 15 hours to the day, the yearly saving of money corresponding to that of one ton in the weight of secondary battery in use would be

$$\cdot 66\text{d.} \times 4{,}475 = £12\ 6\text{s.}\ 1\text{d.},$$

besides the cost of manutention.

The main questions before us are : what can we do to reduce the weight of a traction accumulator, and what must we specially avoid in endeavouring to effect this economy ? The latter question is the sooner answered. We must avoid the usual and very simple plan of removing some of the cells and overworking the others ; *i.e.*, we must avoid too high a current density, and the conditions which render a high current density destructive. We must also, as already suggested, avoid an unnecessarily extended period of discharge ; *i.e.*, with a view to augment the ratio $\frac{h.p.}{\text{H.P.}}$, we must avoid seeking for great capacity simultaneously with a high rate of discharge. Lastly, we must avoid an unnecessary weight of electrolyte.

The question requiring an answer in affirmative form will take a longer consideration. We understand, generally, that durability and a high rate of discharge are the main requirements ; that, to obtain the former, the conducting support

must be, as far as possible, protected from local action, and the active material from disintegration; and that, to realise the latter, the conditions should be such as to render a moderate density of current allowable. By the latter expression I mean a density of current which—although it might be rapidly destructive of a plate not specially designed for accumulator traction—is yet not productive of a very appreciable heating effect, nor of any disruptive effect when the best possible contact is made with the active material, and when this has in itself a sufficient degree of conductivity. More particularly, the requirements may be put in the following form:—

1. We must ensure the production of active materials—peroxide of lead and spongy lead—possessing in the highest degree the chemical and physical properties necessary for efficiency and durability. The peroxide of lead should be hydrated, very coherent, and of comparatively high conductive power. The spongy-lead should be sufficiently porous and yet conductive.

2. We must adopt the most complete and perfect means for establishing contact with the active material.

3. In "forming" the peroxide material, we should operate the conversion from without inwards, and not from the surface of the metallic support, outwards. In discharging the plate, on the other hand, the reducing action and partial sulphating should proceed inwards in the direction of the supporting plate; and this action should never be allowed to extend to the latter.

4. The supporting or conducting plate of the peroxide element should, if practicable, be enveloped in a very dense thin layer of peroxide, which is itself coated with peroxide of greater porosity. In any case, direct contact between the metal and the electrolyte should be rendered very imperfect (though it cannot be altogether precluded) by the intervening layer of active material.

5. In guarding against undue density of current, care should be taken that the sectional area of the supporting or conducting plate be not so diminished as to be insufficient for conductivity or durability.

6. Dilute sulphuric acid of density as high as 1,300 should be used as the electrolyte, provided means are available for obviating or moderating the local action on the lead directly in contact with it which ordinarily attends its use.

7. In traction accumulators—not required to retain charge as "waiting batteries"—the weight of spongy-lead active material should be not much more than half the weight of peroxide active material.

There are three types of secondary battery, viz., that of Planté ("formed" lead plates), that of Faure ("pasted" plates or grids), and that of Frankland (lead cast about lead compound to form active material). In the case of Planté plates, the first four of the above *agenda* are spontaneously supplied.

Six compounds have been more or less extensively used for conversion into "active material in secondary batteries."

(*a*) The "red lead salt" of Frankland [$S_2\ Pb_3\ O_{10} = Pb\ O_2\ 2\ (Pb\ SO_4)$], obtained by the action of sulphuric acid on red lead or minium. This at the outset was used by Faure in producing the active material on both spongy lead and peroxide plates. It is still used for the peroxide plates of the E.P.S. accumulators. Owing to the presence of conducting peroxide of lead in the compound, it facilitates No. 3 of the above agenda. This peroxide of lead, however, is not of the same composition as electrolytic peroxide; being necessarily, from its origin, anhydrous. The active (peroxide) material obtained from it is of a very inferior description, being of exceptionally low conductivity, and "shedding" in the form of a fine powder. It has been shown that the plugs of an E.P.S. peroxide plate, although of such small size, contain in their centre a useless nucleus which constitutes 48 per cent. of the whole mass of the plugs. This compound is particularly to be avoided in the construction of plates intended to have a high rate of discharge.

(*b*) The "buff lead salt" of Frankland [$S_3\ Pb_5\ O_{14} = 2\ (Pb\ O)\ 3\ Pb\ SO_4$)]. This is, for the most part, used for conversion into spongy lead. It allows, however, of the production of a much better (hydrated) form of peroxide than that resulting from the preceding compound. But, as in the case of all compounds resulting from a comparatively sudden and violent chemical reaction, the material "sets" imperfectly, being non-homogeneous and readily disintegrating. The litharge, or, more correctly, *massicot*, from which this compound is obtained should be mixed with a small percentage of electrolytic peroxide of lead, with a view to carrying into effect No. 3 of the above agenda. Through ignorance of this requirement, many plates have been spoiled when this compound has been substituted for the preceding one in the manufacture of peroxide plates. The spongy lead produced from this compound I have found to be of fairly good quality, though somewhat too dense to allow of a high rate of discharge.

(*c*) Fitz-Gerald's ammonia lithanode compound [$(NH_4)_2\ SO_4$ + 38 Pb O, becoming by *gradual* conversion during the process of "seasoning," Pb SO_4, 37 Pb O, with evolution of $2\ NH_3 + H_2\ O$]. The formula given corresponds to 1 of the ammonic salt to 64 of lead monoxide; but these proportions may be varied within wide limits, according to the degree of hardness or porosity required. This compound was patented in 1885, under No. 4,671. When duly seasoned, coated superficially with peroxide of lead, and used as anode in the electrolysis of a solution of magnesic sulphate, it is converted into peroxide of lead of high conductivity. From some cause or causes, which it might be instructive to investigate, it has never been used, except experimentally in my own laboratory, for pasting lead grids or plates. One serious objection there is to its use; it is difficult and tedious to comply with requirement No. 3, as above, since the compound cannot be rendered conductive by the admixture, so useful in other cases, of a percentage of electrolytic peroxide of lead. The latter would be immediately decomposed by the ammonia, with production of a nitrite, according to the equation:—

$$3\ Pb\ O_2 + 2\ NH_3 = NH_4\ NO_2 + H_2O + 3\ Pb\ O.$$

(*d*) Fitz-Gerald's sulphate lithanode compound [Pb SO_4 + 5 Pb O]. The five equivalents of lead monoxide may be increased to as much as ten equivalents, and electrolytic peroxide of lead, equal to half, or even to the whole of the weight of the sulphate, may be added to the two main ingredients. The latter, in presence of moisture, combine with evolution of heat to form a basic sulphate; the mixture "setting" with, sometimes, inconvenient rapidity, to form a dense and hard mass. The use of this compound was patented in 1886 under No. 16,608. To render the set material more porous, the ingredients may be mixed with a solution of sodium sulphate instead of water, or brought into admixture with the solid salt, and afterwards moistened with water. This compound, for some reason, or rather from some cause, has not been brought into use commercially; but excellent peroxide and spongy lead "active materials" can be made from it. The patents for this compound, and for the preceding one, are held, I believe, by the Lithanode Electric Storage Company, Limited.

(*e*.) Fitz-Gerald's alkaline plumbite compound [$K_2\ Pb\ O_2$ + x Pb O]. By the exposure of this compound to the atmosphere, after moulding or "pasting," the oxide of lead contained in it "sets" very gradually and perfectly, and in a more or less hydrated condition, by reason of the slow absorption of carbonic acid by the alkali, and the consequent precipitation of the plumbic oxide previously held in combination by it. When the "setting" process is sufficiently advanced, the plates may, without any danger of disintegration, be immersed in water, by which the greater portion of the carbonated alkali is removed in solution. They are then immersed in a half-saturated solution of sulphate of magnesium—to avoid the violent evolution of carbonic acid from the carbonate of lead always present to some extent. Lastly, the plates are immersed in a solution of the same salt acidulated with sulphuric acid, in which solution they may be "formed." According to the percentage of alkali used, any required degree of porosity may be obtained with very little loss of cohesive strength; since, with the vegetable alkali, no disintegrating crystallisation or efflorescence can occur. A percentage of electrolytic peroxide amalgamates very kindly with the other ingredients, and communicates a useful degree of conductivity to the unformed material. The use of this compound was patented in 1893, under No. 9,906. It has not yet been employed commercially on a large scale.

(*f*.) The lead-zinc chloride compound. This is a mixture of Pb Cl_2 with Zn Cl_2, used by the Chloride Electrical

Storage Syndicate, Limited, for plates of the Frankland type only. The object of adding the zinc salt, the percentage of which may vary from 3 to 10, is two-fold: in the first place it prevents the lead chloride from splitting into fragments by the effect of contraction after fusion and casting into tablets, and, secondly, it gives any required degree of porosity to the lead obtained by the reduction of the chloride of this metal. The peroxide of lead obtained by the conversion of the porous lead may also be obtained of any required degree of porosity. It is claimed that the reduced lead is of a crystalline nature and is possessed of a comparatively high degree of conductivity—qualities which are reproduced in the resulting peroxide. The use of this compound was patented in this country, as a communication from M. A. Marchenay, Paris, in 1885, under No. 2,765.

(*To be continued.*)

FRENCH SUBMARINE CABLES IN THE INDIAN OCEAN.

We read in *L'Eclairage Electrique* of the 25th ult., that some months ago Messrs. de Mahy and Louis Brunet deposited, at the office of the Chamber, a draft bill relating to the establishment of a submarine telegraph cable between Tamatave, Reunion Island, and Mauritius. This proposal has been submitted to the Budget Committee, and recently Mr. Boudenoot, deputy, has, in the name of the Committee, reported very fully upon it.

In this report, the author points out that in 1894, the commission formed to study the question of submarine cables, working together with the Direction General of Posts and Telegraphs, has had (foreseeing the military developments which have since occurred in Madagascar) to occupy itself particularly with the telegraph communication of this island, and had prepared a project for the organisation of the following lines:—

1. Cable from Mozambique to Majunga.
2. „ „ Majunga to Nossi-Bé.
3. „ „ Nossi-Bé to Diego-Suarez *viâ* Courrier Bay.
4. „ „ Tamatave to the Island of Reunion.
5. „ „ Reunion Island to Mauritius.
6. „ „ Tamatave to the Island of St. Mary.

Only the first of the six sections mentioned above has been completed up to the present time, and the proposal of Messrs. de Mahy and Brunet is to obtain the speedy establishment of the fourth and fifth sections by—1st, a cable which, starting from Tamatave and touching at Mauritius, would communicate (having previously touched at Reunion) with the English line, which, from Zanzibar, reaches Mauritius, landing at the Seychelles on the way. 2nd. An overhead line between Majunga and Tamatave, passing by Tananarivo, and utilising the line already existing between the two latter places.

The length of the cable from Tamatave to Reunion and Mauritius would be 600 miles, of which 460 miles would be laid between Tamatave and Reunion, and 140 miles between Reunion and Mauritius. The reporter on the proposal estimates the cost of making this cable at £61,904, and the total expense of establishment £104,000, under reserve of rebate in the adjudication.

The establishment of a double wire landline between Majunga and Tananarivo, the consolidation of the existing line from Antanarivo and Tamatave, together with the addition of a second line between these places, is estimated to cost £16,680.

The total expenditure necessary to realise the proposal of Messrs. de Mahy and Brunet thus amounts to £120,680. To this the reporter adds a sum of £20,040 for a repairing ship to look after these cables, as well as the remainder of our network of submarine cables in the Indian Ocean.

The annual cost of maintenance is estimated at £8,988 for the cable, and £1,668 for the landline. The cost of working is taken at £9,580.

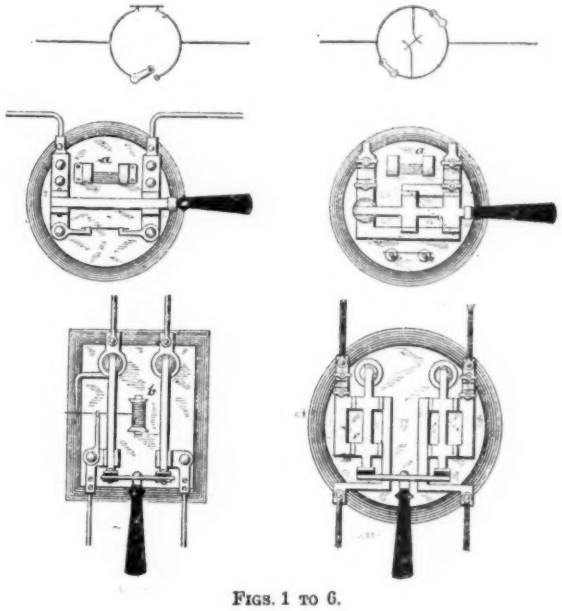
As to receipts, one can hardly give a figure; but anyhow one may count on an annual subsidy of £3,000, which the Council-General of Reunion is disposed to vote, to assist in the execution of this project.

NON-ARCING SWITCHES.

The interruption of electric currents of large units, the breaking of circuits of high power to produce the least disruptive and damaging effects from arcs, is a problem which must grow, says S. D. Mott, in the New York *Electrical World*, in importance with the constant increase of potentials employed in modern electrical distribution and installation. The efforts of designers to minimise the blister and consequent damage of metallic contacts has been by (*a*) quick breaks, (*b*) blow-outs, magnetic and otherwise, and still others by disposing the ultimate break on removable contacts of carbon.

The present design is a change in that it aims to prevent the arc in the first instance at the switch proper by diverting it where its harmful effect will be *nil*. This is accomplished in figs. 1, 3 and 5 by causing the current to flow through a divided circuit, in one limb of which is a fuse of predetermined carrying capacity; in the second instance this is accomplished by means of a bridge circuit, figs. 2, 4 and 6, in the neutral branch of which is a similarly conditioned fuse.

In the one case the fuse carries part of the current, as it bears a shunt relation to the brake, and in the second design the fuse is devoid of current until the switch is thrown, when the whole current is on the fuse, ensuring its immediate destruction. In either case, the circuit is *not* broken by the



Figs. 1 to 6.

switch movement, but the effect is to throw the whole current on the fuse, which instantly blows, thus relieving the contacts proper from damage.

Experiment with the first arrangement of circuit (figs. 1, 3 and 5) shows that the rating of the fuse should be about one-tenth the amperage of the current flowing. At this rating and proper length it has been observed that there is an entire absence of spark at the metal surfaces.

The dotted line (fig. 4) on single-throw bridge switch shows the neutral points for fuse connection, which in this case are led out to the face of base; in the double-throw bridge switch (fig. 6) the fuse terminals are supposed to be on the back side of the base.

It is deemed best to have the blade on the right of fig. 2, longer than its mate, to ensure the blowing of fuse.

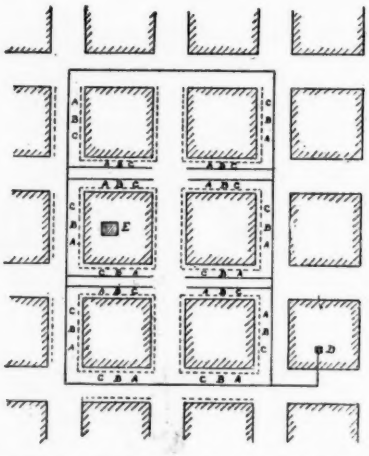
The match-box like receptacle at *a* is to conveniently hold out fuses for renewals after the switch has been thrown; *b* is a spool of fuse likewise ready for use. By attaching a mechanical counter to spool *b* the number of throws of the switch during a certain period may be known if for any reason this were desired.

All the illustrations are arranged for manual renewal of the fuse; it can be arranged, however, for automatic action with some additional expense.

THE NEW THREE-PHASE ELECTRIC LIGHTING SYSTEM AT SALT LAKE CITY.*

In August, 1895, it became necessary to make immediate provision to increase the dynamo capacity in Salt Lake City, in order to meet the demand for lighting. A contract had been made with the Big Cottonwood Power Company for the supply of power, but there was no prospect of getting this power until the spring of 1896. By this contract the Big Cottonwood Power Company have undertaken to develop a water power in the Cottonwood Canyon, and transmit electricity over a distance of 14 miles into Salt Lake City, and there to sell the power to the Salt Lake and Ogden Gas and Electric Light Company. This undertaking was fully described in the *Electrical Engineer* of September 12th, 1895. The Big Cottonwood Power Company will instal a three-phase alternating system with a 10,000-volt transmission, stepping down at the distributing station in Salt Lake City to 2,000 volts. With these plans in view it was deemed advisable to put in three-phase dynamos at the Salt Lake electric light plant of sufficient capacity to supply the commercial centre with incandescent lights, and machinery for this purpose was purchased from the General Electric Company, and erected last November.

Generators.—The generating machinery consists of two 150-kilowatt and one 50-kilowatt three-phase alternators.



A B C, Transformers; D, New sub-station; E, Old electric light works; Full lines, 2,000 v. 3-phase mains; Dotted lines, 115 v. 3-phase secondaries.

Fig. 1.—Plan of Primary and Secondary Mains in Commercial District.

One of the large dynamos is belted to a countershaft with other dynamos and driven by a 600 horse-power Corliss engine, which runs at 100 revolutions per minute. The second is driven off the fly-wheel of a 250 horse-power cross compound Armington & Sims engine, running at 230 revolutions. The third dynamo is used for the day load, and is driven off a 150 horse-power cross compound Armington and Sims engine, together with two Edison dynamos used to supply power.

All the dynamos are designed for 60 cycles. They are compound wound and have iron-clad armatures of the latest type. The 150-kilowatt dynamos are wound for an output of 2,300 volts and 37 amperes at a speed of 600 revolutions; the 50-kilowatt dynamo is wound for an output of 2,300 volts and 13 amperes, at a speed of 900 revolutions. The manufacturers guarantee a commercial efficiency of 94 per cent. at full load on the large dynamos, and a temperature not to exceed 70° F. above the temperature of the surrounding atmosphere, after a continuous run at full load for 10 hours. There has been no opportunity of testing the dynamos for efficiency at present, but they come well within the temperature guaranteed.

Switchboard.—The switchboard consists of five slabs of pink Tennessee marble, 90 inches high by 30 inches wide. Three of the panels contain switches for each of the three dynamos. One panel is for the measuring instruments, and the fifth panel is for the circuit switches and voltmeter. The dynamo panel is fitted with a Carpenter enamel rheostat for regulating the exciting current; one exciter double-pole switch; one three-pole main switch; one equaliser switch, for parallel running; one ammeter for measuring the main current on one leg of the three-phase system, and three high-tension fuses and a synchronising switch. At the back of the board are the three high tension mains' bus bars, the equaliser bus bars for connecting all the compound windings together, and three lightning arresters of the T.-H. magnetic blow-out type, with an additional protection of a flat coil of a few turns of large wire between the arrester and dynamo. Each dynamo has one transformer, which is so connected to a bus bar that, by throwing a small switch, it can be used for lighting a pilot lamp, or be put in series with the other transformers for synchronising.

The effective current, as measured at full load on one wire of the dynamo, is 37 amperes upon the larger and 13 amperes upon the small dynamo. The total effective current on the three wires is about 1·73 times that on one wire. This being the ratio between the ordinates on one sine curve and the added ordinates of three sine curves at phase angles of 120°. On the instrument panel are three main amperemeters for registering the whole current sent out on each leg of the system, and also a Thomson three-phase wattmeter. This wattmeter is simply a modification of the ordinary Thomson meter, and consists of three separate meters, the armatures of which are all on the same spindle. On the fifth panel are arranged four three-pole circuit switches, four sets of circuit fuses, and a Thomson-Houston voltmeter, arranged with a switch for connecting to any dynamo or any circuit. In addition to these instruments a Bristol recording voltmeter

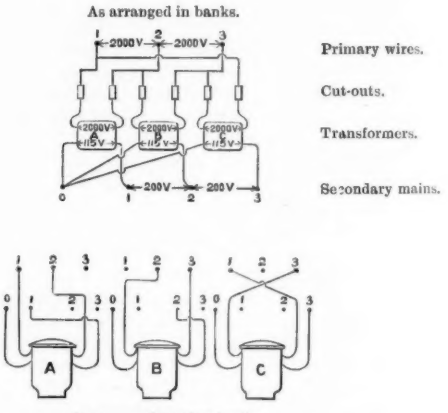


Fig. 2.—Transformer Connections, 3-Phase System.

is fixed in the station. The whole board is protected by a wooden canopy, presents a very handsome appearance, and is extremely simple to manipulate.

The compound commutators of the dynamos run absolutely sparkless, and there is no trouble at all in synchronising. It may here be mentioned that the self-induction in the armatures of these dynamos is such that it is impossible to do any damage by a short circuit. Shortly after starting, a short circuit occurred on the main lines, while the small dynamo was running; the result was that the potential at the dynamo dropped off, just as if the exciter switch had been suddenly opened, and furthermore, the dynamo would not give any potential at all when running upon the short circuit. These dynamos, however, will carry 25 per cent. above their rated capacity, without any loss of pressure.

The Distributing System.—The distributing system consists of a three-wire high tension network, and a four-wire network of secondary mains. The accompanying plan (fig. 1) shows how these mains are distributed over the business district. The transformers are placed upon the poles which carry the wires, and the connections are made as shown in the diagram, fig. 2.

In carrying out a system like this, it is, of course, important that the transformers should be fixed quickly, without any fear of getting the connections wrong. In order that the linemen may not be able to make any mistake in this,

* New York *Electrical Engineer*.

the wires on the poles are numbered, as shown, and the transformers are also lettered. The diagram also shows the position in which the transformers are placed in the streets, and the arrangement is such, that in case of fire, it would be very easy to cut off one portion of the district without interfering with the rest of the lighting.

In order to save the loss in transformers during the hours of light load, arrangements are being made for cutting out a certain number of the transformers during the daytime, leaving the rest to supply the secondary mains. The transformers are wound for a ratio of 18 to 1, and it will be noticed that the secondary mains consist of a neutral wire and three others. By this means it is possible to get 115 volts between the neutral and any of the three other wires for incandescent lighting, and 200 between any two of the other wires for motor service.

With the exception of one or two little difficulties inseparably connected with installing such a system as this during the heaviest lighting season in the year, there has been no difficulty whatever, and the dynamos and all other apparatus work perfectly. There is no difficulty in balancing up the three legs of the system, and, in fact, once the transformers and the secondary mains are fixed, it is said to be easier to manipulate than an Edison three-wire system.

As soon as the Cottonwood power station is ready for work, the preparation will be commenced for connecting the residence district on the three-phase system. At present these districts are supplied on the ordinary 1,000 volt single-phase system. The diagram, fig. 3, shows how the connections will be made for the three-phase.

The arrangement of the streets in Salt Lake City are convenient for carrying out the necessary changes. The streets run north and south and east and west. The existing 1,000 volt mains run east and west. The three-phase feeder, as shown, will be brought up one of the streets running north and south through the centre of the residence district, and each of the streets will be attached to this feeder, as shown

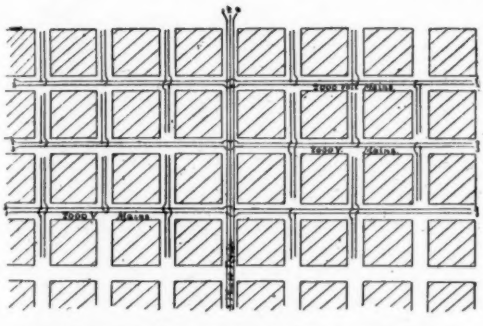


Fig. 3.—Three-Phase System of Mains in Residential District.

in the diagram; thus, where there are three streets, each one of the streets will form one leg of the three-phase system, and the three legs will be balanced by throwing the side streets on to whichever leg requires strengthening or weakening, as the case may be. All the transformers at present installed in stores are wound for 1,000 volt primaries and 52 volt secondaries. Some of the stepdown transformers, supplied by the Big Cottonwood Power Company, can be connected for 1,000 volts, and it is proposed to connect up the three-phase feeder to the distributing station, as shown in the diagram, at a pressure of 1,000 volts. The existing transformers would not be very efficient at 60 cycles per second, but as quickly as possible the old type transformers will be transferred to Ogden, while new type transformers will be fixed in the residence circuits, and then, as soon as sufficient new type transformers are fixed, the voltage will be raised to 2,000, and the house lamps changed from 52 to 104.

This is an outline of the system proposed to be pursued in changing over the residence district from the existing system to the new three-phase system. It will necessarily take some time to carry out this work, but there are portions which can very easily be connected up, while it will take several months to prepare other portions of the town.

In a great many parts of the residence district the houses are so close together that it is very easy to fix one or two transformers to supply 10 houses. These transformers will be fixed on the street poles, and a short length of secondary mains will be run, from which the houses will be supplied. At these places it is proposed to place two transformers, one, say, for 100 lights, and another for about 20, with an automatic switch to cut out the larger transformer, when the number of lights does not exceed the load of the smaller, and so save the loss of power at light load.

From the fact that the installation presents so many points of new and improved central station practice, its operation will be watched by electric light and power men throughout the country with keen interest. The active conduct of this important undertaking has devolved on Mr. R. F. Hayward, the well-known general manager of the company, who has carried it to its present successful stage with characteristic energy and ability.

THE RÖNTGEN RAYS.

Some interesting quantitative results as to the rate of leakage of electricity through different gases under the influence of the X rays, have recently been obtained by J. J. Thomson and McClelland. They found that in general the rate of leakage increased with the atomic weight of the gas, although there were exceptions to this rule. The leakage through the halogens is remarkably rapid; the gas through which the rate of leakage was greatest was mercury vapour, though the ordinary electric discharge passes through this gas with great difficulty. The connection between the rate of leak through a gas and the potential difference was found to be remarkably similar to the relation between ampere-turns and the magnetism induced in a bar of iron. When the potential difference does not exceed 2 or 3 volts, the rate of leak is proportional to the potential difference. On increasing the potential difference, a stage is reached when the rate of leak increases more rapidly than the P.D. With still higher P.D., the rate of leak is almost independent of the potential difference. The rate of leak through solid dielectrics such as paraffin was found to follow Ohm's law up to the highest P.Ds. used in the experiments.

A very interesting paper on X rays, by Prof. S. P. Thompson, was presented to the Académie des Sciences on April 7th by M. Mascart. The learned professor states that research into the conditions under which the X rays are produced in the Crookes tube was much facilitated by the use of fluorescent screens. For this purpose he had tried several different kinds of screens; a screen of black cardboard, thinly coated with powdered potassium platino-cyanide was found to be the best. He had tried, among other substances, sulphides of calcium, strontium and zinc, hexagonal blende, fluoride of calcium, tungstate of calcium, and several platino-cyanides. The potassium platino-cyanide was at least 12 times more luminous than that of barium used by Röntgen. The light is bluish, and has, according to Mr. Jackson, who has recommended it for the cryptoscope, a spectrum the same as that of potassium.

By examining a Crookes tube during the process of evacuation, Prof. Thompson has discovered several important facts. The tubes which he has used have been pear-shaped, with a concave cathode, sometimes interior and sometimes exterior, to concentrate the cathode rays upon a central piece which served as an origin of the X rays.

This piece, which he calls the anticathode, may also be used as an anode. In most of his tubes this piece consisted of a sufficiently thick and bare plate of platinum, but he also used successfully plates coated with a phosphorescent glass or enamel, composed of sulphide of calcium and ordinary transparent enamel. It is convenient to fix the anticathode in a position making an angle of 30 to 40° with the axis of the apparatus. With such a tube 40 seconds is sufficient for a photograph of the hand, and 20 seconds for that of money in a purse. Prof. Thompson prefers to use the Ruhmkorff coil; he found that the Tesla coil heats the tube, without augmenting the useful effect, and it spoils the shadows and photographic impressions owing to the existence of two sources of cathode rays.

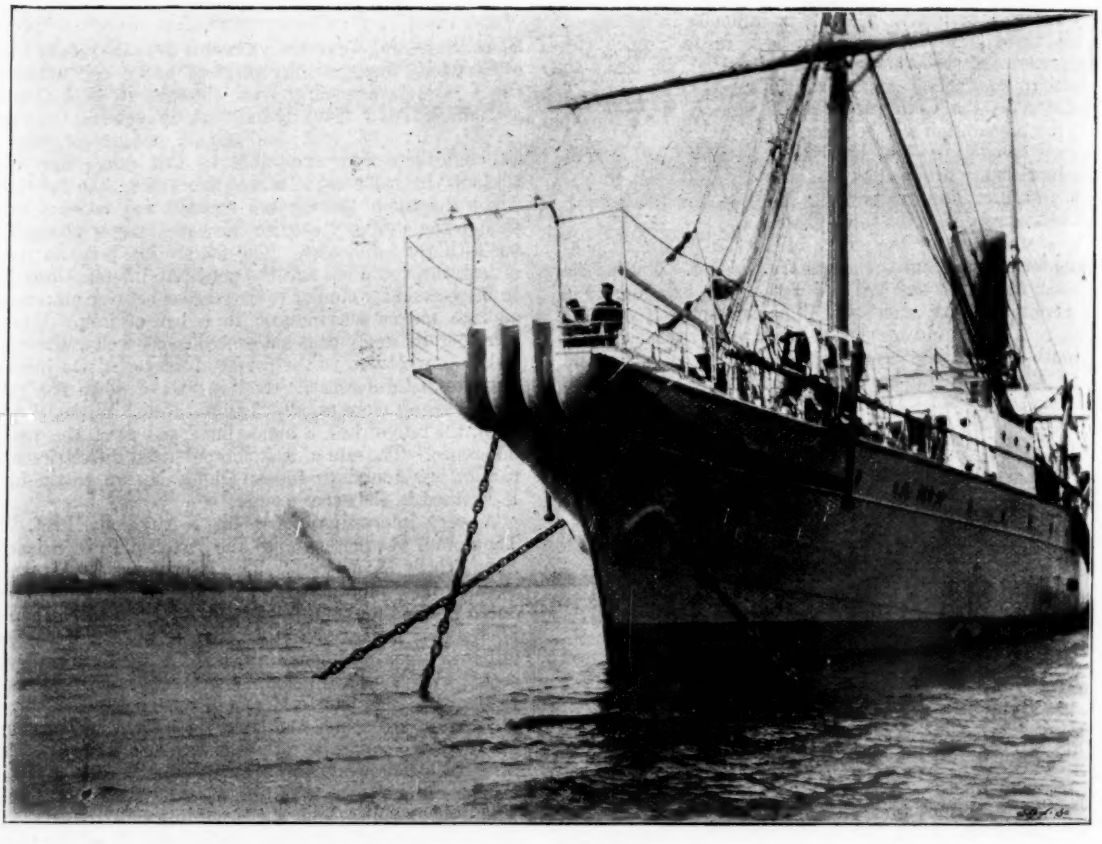
To get a tube capable of producing the X rays in the best condition, it is not sufficient to produce a vacuum of a degree capable of showing Crookes phenomena (cathode

shadows, phosphorescence, &c.). When the first phosphorescent gleams appear in the tube, the vacuum is far from being perfect, and the apparent electric resistance is very small. During the evacuation, the variation of the resistance can be observed by the length of the parallel spark in air. The Crookes phenomena may be obtained when this spark does not exceed 2 mm. Under these conditions the fluorescent screen does not show the least trace of X rays, although the photographic plate will be impressed with a sufficiently long exposure. But on proceeding with the evacuation, a sudden increase of resistance takes place, such that it is necessary to open the parallel spark gap to several centimetres. It is exactly at the moment when the resistance suddenly increases that the X rays flash out. If the tube has never been evacuated before, the transition from a state of feeble resistance to that of greater resistance, does not take place so suddenly; but if the tube has already been brought into higher, if the coil is sufficiently powerful to send a spark through; the risk of breaking the tube becomes, however, very great.

The variation of the character of the rays with the potential difference at which they are produced, can be well shown by the screen. By looking at the hand with a tube in which the vacuum is increasing, it will be found that the best contrast between the bones and the flesh will be obtained with a middle vacuum, above and below which the contrast is less marked.

The above contribution of Prof. Thompson contains many new and interesting points about the X rays, and will be of the greatest value in the practice of Röntgen photography.

Mr. Wm. Ackroyd and Mr. H. B. Knowles have made some experiments which appear to show a connection between the colour of bodies and their transparency to the X rays. For instance, oxide of aluminium is white and transparent



New Japanese Cable Steamer.

the second state, and a little air is then admitted, and again pumped out, the transition from the first to the second state is absolutely abrupt.

When the tube is examined by a phosphorescent screen during the transition, at the very moment when the resistance increases a glimmer is seen all over the tube, except in the plane of the anticathode; this plane is shown by a sharp black line on the screen, lying between two bright regions, the one in front of the cathode, the other behind it. The two regions have, at first, an almost equal luminosity; but as the evacuation proceeds still further, in two or three seconds the phenomena change. The region behind the anticathode becomes darker, that which is in front becomes brighter, till finally, a dark region and a luminous region, separated by the plane of the anticathode, are visible on the screen. The tube is then in the best condition for producing the Röntgen effects, either photographic or fluorescent.

The effects continue when the vacuum is pushed still

for X rays, oxide of chromium is green and semi-opaque, and ferric oxide is brown and opaque to X radiation. They have found a similar law to hold with other groups of substances.

Mr. Ackroyd has already published some ingenious speculations on the cause of the colours of bodies and beasts, which, if considered in connection with his present experiments, may help to tell us how the X rays pass through material substances. If we recollect rightly, in Mr. Ackroyd's theory white bodies were characterised by having the atoms or molecules packed closely together, while in dark bodies they were separated by greater or less distances. The superior transparency of white bodies would, therefore, indicate that the X rays must pass through the substance of the molecules, and not through the spaces between them.

Tesla's experiments on the reflection of X rays have led him to a remarkable conclusion—which, however, requires further confirmation, as he himself admits. He finds that if

metals are arranged in the order of their efficiency as reflectors of X rays, the order is the same as that of the voltaic series. For example, magnesium, lead, tin, iron, copper, silver, gold, platinum is a series in which the last-named metal is the poorest reflectors. We have the impression that other experimenters have found platinum to be one of the best reflector. Tesla builds on this rather shaky foundation a vast superstructure of speculation which appears in the present state of our knowledge to be at least premature. He appears to have got good results by immersing his X ray tube in insulating oil, and he points out the interesting fact that the relative transparency of bodies to the X rays varies with the distance from the tube. He found that J. J. Thomson's theory that insulators were transformed into conductors by the X rays, was not confirmed when the resistance was tested by high frequency currents.

The controversy as to the source of the X rays appears now to have settled down. Even Prof. Rowland now gives up his anode theory, or, at least, admits that the anode is only the source of the X rays when it is struck by the cathode stream.

Prof Bungetziano, of Bucharest, has observed certain fringes round the X ray photographs which he considers to be evidence of diffraction; but similar experiments made by Prof. Stine, of Chicago, and others, make it probable that these fringes are merely penumbra, due to the fact that source of the rays is not a mathematical point.

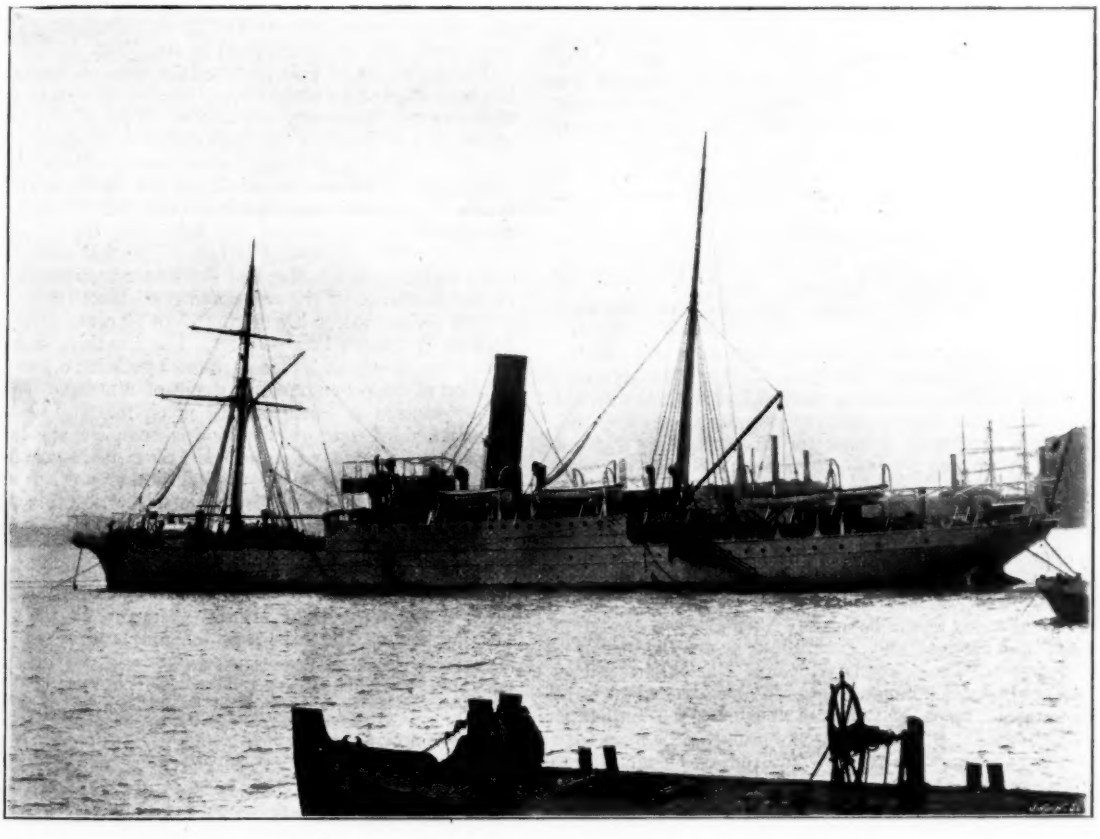
Mr. Edison finds that when the X ray tube is placed in a freezing mixture, the bones and flesh of a hand become equally transparent, so that the one cannot be distinguished from the other. These experiments, taken with those already mentioned of Prof. S. P. Thompson and Tesla, appear to show that the relative transparency of bodies to the X radiation varies with the temperature, the vacuum, and the distance from the tube.

M. Colardeau, of Paris, has constructed an X ray tube no larger than a cigarette, by which very sharp Röntgen photographs can be taken.

An interesting practical application of Röntgen photography is described by M. Ranwez in *L'Industrie Electrique*, viz., for the detection of mineral adulterations in vegetable substances. For instance, sulphate of barium, which is used to adulterate many substances, can usually be readily detected by its great opacity to the X rays. Adulterations of food stuffs, saffron, &c., have readily been detected in this way, and there can be little doubt that in this direction there is a wide field open.

THE NEW JAPANESE CABLE STEAMER.

We give herewith two photographs of the Japanese cable steamer *Okinawa Maru*, which were taken in the River Thames while she was loading up telegraph cable. Illustrations of the cable laying machinery with which the vessel is equipped have already appeared in our columns. One is a general view of the ship, and the other shows the stem with the bow sheaves and whiskers.



New Japanese Cable Steamer.

American v. English Machinery.—At the Institution of Mechanical Engineers' ordinary general meeting, last week, Mr. Jeremiah Head mentioned the fact that in America, notwithstanding that conditions were very much against the manufacturer in many respects, they yet managed to manufacture machinery not only for their own use, but exported it largely to countries where they became our competitors. In addition, large quantities of American machine tools actually found their way into English shops.

SECTIONAL COILS FOR FIELD MAGNETS.

In calling attention to breakdowns in the insulation of 500-volt shunt field-magnet coils, which appear to be frequent in the States, the *Electrical World*, N.Y., suggests a method of winding the coils in a number of sections, similar to the plan usually adopted in induction coils. The comparative arity of a 500-volt dynamo in this country has, no doubt, prevented our station engineers from becoming acquainted with disasters of this kind. Our experience in this direction is, to a great extent, limited to the behaviour of the field-magnets of large alternators. These are usually excited by a current of a considerably lower pressure than 500 volts, so that voltage of the extra current produced when the field circuit is interrupted, is not generally sufficiently high to puncture the insulation. In the case of very large alternators, such as those at Deptford, the energy stored up in the magnetic field is very considerable, and special precautions are necessary to avoid the sudden interruption of the exciting current. Such machines, as a rule, have independent exciters, and, when the alternator is disconnected from the mains, the switches in the exciting circuits are not, as a rule, opened until the exciters have themselves been shut down, and the exciting current has died away to zero. The behaviour of the exciting current when the exciters are stopped is very interesting. In consequence of the immense self-induction of the massive magnets of a large alternator, the current in the exciting coils takes a very appreciable time to die away, and even after the armature of the exciter is at rest, exciting current still passes for several seconds. In cases of emergency, it may, of course, be necessary to open the exciting circuit, but this should be done by means of a switch shunted by a water resistance, through which the extra current from the field magnets may pass, so that the energy stored in the magnetic field may be gradually dissipated.

With the development of electric traction in this country we may expect the extended adoption of large shunt dynamos wound for 500 volts or so, and sectional winding of the field coils, as suggested by our contemporary, may come into use. Among the advantages claimed for this method are that the voltage between two layers of a sectional coil will be comparatively small, so that the risk of a "short" between two layers would be minimised. A fault could also be readily localised and repaired without rewinding the whole coil. In case of emergency a damaged coil could be short-circuited or disconnected altogether, and the machine might still be kept at work. The machine being shunt wound the effect of cutting out a coil would be merely to make the excitation slightly less efficient, and there would be no diminution in the electromotive force of the dynamo. The chief objection to sectional winding besides the additional cost seems to be that valuable space will be occupied by the insulation between the coils, which space would otherwise be filled with wire. The voltage of the extra current from the fields of a large 500 volt generator, when the exciting current is interrupted, may easily amount to several thousand volts, and if it were arranged to open the exciting circuit suddenly, the sectionally wound coils would require to be very effectually insulated from the metal of the machine. In any case we should consider it to be advisable to shunt the exciting current switch by means of a water resistance, which would allow the energy stored in the magnetism of the field magnets to be dissipated without danger.

THE SIEMENS & HALSKE PROCESS AT THE MAY GOLD CONSOLIDATED COMPANY.

When, two or three months ago, statements were published in certain contemporaries announcing that the electric recovery of gold from its cyanide solution was a failure in some Transvaal mines, and that the May and another company had abandoned the Siemens & Halske electro-deposition system, to return to the MacArthur zinc process, we did not hesitate to flatly dispute the accuracy of such news, and to assert that no zinc or other chemical process for precipitating gold can compete in efficiency with a well understood and practical electro-depositing system.

Our contention was, and is still, that for weak, as well as for strong gold cyanide solutions, the electrolytic recovery of gold is much superior to the MacArthur process, which is based on the reducing action of zinc. By the way, the rumour had also spread that the MacArthur-Forrest Company had withdrawn their claim to the zinc shavings patent in the suit pending in the Transvaal; this is now contradicted. Such abandonment was, it appears, never thought of, and everyone will easily understand that although the use of zinc in a state of fine division or shavings has been known many years for reducing metals, the MacArthur Company could not disclaim the use of zinc, which is its stronghold before the Courts. Strongholds do not always hold out. The reducing properties of zinc were not discovered by MacArthur and Forrest, and who can prevent anyone from precipitating gold from its solution by means of zinc?

In his paper on "The Precipitation from their Solutions by Means of Zinc of some of the Metals, considered up to the Present as not Reducible" (*Comptes Rendus de l'Académie des Sciences*, xiii., p. 453, 1844) Becquerel said:—It is enough to immerse in the solution a metal more easily oxidisable than the dissolved metal. Its substitution takes place in atomic proportions. In this way solutions of copper, *gold*, silver, &c., are decomposed by zinc, iron, &c.

The deposition of gold by zinc in a state of fine division has been effected by several inventors, but did not give practical results. Some very remarkable effects of oxidation by means of zinc shavings had been obtained by Schutzenberger in 1879. Naudin, in a paper read before the Paris Chemical Society, explained how he disinfected raw alcoholic liquids by means of coppered zinc shavings, and the following is a description of his method for depositing copper on zinc shavings, which, as a matter of fact, is identical with the process adopted by MacArthur and Forrest for precipitating gold on zinc shavings. "The zinc shavings are placed in a wooden, copper, or iron vat, in layers from 15 to 20 centimetres thick, kept up by wooden false bottoms. The first thing to be done is to form a couple. This is done by adding a 5 per cent. solution of copper sulphate by means of a pump. When the copper solution is colourless, the precipitation of copper in a finely divided state on the zinc is complete, and the zinc copper couple is ready for use." Let the metal be gold instead of copper, and we have the precipitation of precious metals, the monopoly of which is claimed by the MacArthur companies.

But to return to our subject, every electro-chemist will read with pleasure the following lines, which we extract from the report read by Mr. R. G. Fricker, director of the May Consolidated Gold Mining Company, at the general meeting held on March 26th at Johannesburg.

> The working cost of the cyanide by the Siemens-Halske process amounted to 3s. 3d., including royalty, while the value of the yield was 14s. 2d., giving a profit from this department of 10s. 11d. . . . . As already stated, the process adopted was that of Siemens-Halske, a process which has in every way proved successful, not only in the extraction of 79 per cent., but also in the fineness of the bullion recovered, which averaged 875 and realised 73s. 8½d. per oz., while the working cost was 3s. 3d., and the profit 11s. 1d. per ton treated. The old plant taken over from Messrs. Lace and Thompson proved a great source of profit, and completed its work last October. The increase in the capacity of the new plant will, however, more than compensate for the profit hitherto received from that source. I think, therefore, that our experiment—and it was looked upon as an experiment at the time we signed the first contract with the Rand Central Ore Reduction Company—has proved eminently satisfactory.

Comments on this declaration would be superfluous. Who can now pretend that the electro-deposition of gold from its solution is not a commercial success?

CORRESPONDENCE.

Kamm's Telegraphic Typewriter.

I thank you for your note in reference to the above in your issue of the 24th inst. I am quite content with your criticisms as a whole, and I wrote my letter simply with the view of eliciting your opinion definitely as to whether the invention possessed the distinct points of novelty which seemed to me to constitute its chief merit. Your confirmation of my view as to this is quite sufficient, while your very

courteous offer to give the invention further trial when we are ready for it is, believe me, highly appreciated. I admit the justice of your strictures on the mechanical defects of the first pair of instruments which, of course, were largely experimental; but I have every confidence in Mr. Kamm's ability to improve greatly upon them in the new machines, which are, indeed, already well in hand.

W. Gentry Bingham.

Paris, *April 29th*, 1896.

LEGAL.

Electric Construction Corporation *v.* South Staffordshire Tramways Company.

In the Chancery Division of the High Court of Justice, on 30th ult., the hearing of this action and counterclaim was resumed by Mr. Justice Romer.

Mr. Thomas Parker, in further cross-examination by Mr. Eve, said that in January, 1884, several of the directors desired him to continue as works' manager, and when he refused he was requested to remain in the employ of the plaintiff company as consulting engineer at a salary of £1,000 a year. He gave notice to the company on February 14th, 1894, that he should leave their employ at the termination of his agreement on May 30th, 1894, and on April 9th the company wrote asking that the employment might cease forthwith.

Mr. Eve said this evidence rendered it necessary that he should call the directors of the company, as his information was that witness had never given any intimation to leave until he wrote the letter of February 14th, 1894, and that instead of requesting him to continue in the service of the company, it was desired that his engagement should terminate before the end of the agreement.

Sir F. Lockwood said he should oppose any application to call witnesses after the plaintiffs had closed their case, particularly as he put to Mr. Courtney the question whether it was not the fact that Mr. Parker informed him of his belief that the contract was of such an onerous nature that it would be impossible for the defendant company to survive it. The allegation against Parker was that he was a dismissed servant of the company, and was consequently prejudiced against the company. It was not until now that he learned of the letter giving notice of the termination of Parker's agreement, which was sent to the plaintiff company on February 14th.

Mr. Justice Romer said he would consider the application.

Further evidence was then given by Mr. Kenway relative to the details of the tramways in question. In his opinion, it was not inconceivable of the company to try electricity as a substitute for steam, provided the terms were all right. One reason why he objected to the contract as improvident was that the minimum mileage was in excess of the past experience of the company. As matters stood at the end of 1891, he considered the company could have put their engines into repair, or have obtained new ones, and that they could have done this with the money they were unprofitably using elsewhere. He thought the debentures of the defendant company when issued were not worth par, though the interest on them was fixed for some time.

Mr. Frank William Hardcastle, chartered accountant, who was appointed auditor to the defendant company by the shareholders in 1894, said he had gone through the books of the defendant company, and found that in addition to the 9d. paid under the contract, the expenses of the tramway company would be practically 3d., and then there was the interest on the £15,000 debentures. In 1893, the books showed a loss on the year's working of upwards of £2,000, and in 1894 the loss was £2,580.

Cross-examined: In 1891 the defendant company was not in a position to pay cash for any part of the electric installation.

Mr. John Waugh, civil engineer, said he had examined the contract and balance-sheets of the defendant company, and he was confident the company could never have carried out the contract with any hope of success.

Mr. Henry Lea, civil engineer, of Birmingham, in practice for 34 years, and having some experience in the working of tramways, said his attention had been called to the contract. From the information supplied to him, in his opinion, the provision for a minimum run of 250,000 was excessive, having regard to the district. Taking that into consideration, together with the 9d. per mile to be paid, he considered it to be a contract of such an onerous character, that it could not possibly be carried out. The amount charged for the laying down of the plant was excessive, but he had not seen the plant of the plaintiff company. A sum of £28,000 would, in his opinion, have been a reasonable sum.

Cross-examined: His estimate of a fair price was derived from the specifications, as he had not seen the plaintiffs' plant or buried feeders. He meant that £28,000 would be a fair sum, if paid in cash, and not that it would be a fair price if payment were spread over a period of five years. If payment were spread over five years, he thought 4 per cent. should be paid on the £28,000.

In re-examination, Witness said that the plaintiff company refused an application made by him to inspect the plant.

Mr. R. Green, a civil engineer in the employ of Messrs. Pritchard and Co., of Birmingham, as manager, said he was experienced in tramway matters. With a knowledge of the district through which the defendant company ran, he gave it as his opinion that no one in the position of the defendant company should have reasonably been asked to enter into the contract.

Cross-examined: In 1891 the effect of introducing electricity as a tramway motor was more or less guess work. His experience was that where an accelerated form of traction was introduced, the traffic was increased, and increased profits were the consequence. By steam traction the traffic was limited to the number of engines; but where they had electric or cable traction, there was not the same limit to the number of cars that could be run.

In re-examination, Witness said this particular district was not a growing one, and though the electric system might multiply the service, they might soon reach a point where such multiplication would mean ruin.

Mr. Henry Hatchett, of Walsall, the secretary of the defendant company, said he knew Mr. Ebbsmith, and detailed how that gentleman was connected with the company. He also knew Mr. James Carruthers Wain, who was chairman of the company up to 1894. The qualification of the directors was 250 shares. Mr. Dickinson was the general manager and engineer of the company, at a salary of £500 per annum. Under his contract Dickinson was to devote the whole of his time to the defendant company. Mr. Ebbsmith was regarded as an expert in tramway matters by reason of his connection with the Birmingham tramways. Witness then gave evidence with regard to the meetings being packed by bogus shareholders in 1888 and 1889, and was then examined to show that the debentures found their way into the hands of Ebbsmith.

At this juncture the Court rose for the day.

Further evidence was given on Friday, judgment being reserved.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending May 1st, 1895.	£	s.
Algoa Bay. Telph. matl.	158	0
Amsterdam	25	0
Bombay	102	0
Brussels. Teleg. matls.	80	0
Calcutta	40	0
Cape Town	168	0
Christiana	35	0
East London	1,589	0
Freemantle (cable) ...	289	0
„ Teleg. matl.	76	0
Madrid	98	0
Mauritius	38	0
Penang. Teleg. matl.	79	0
Melbourne	524	0
„ Teleg. matl.	75	0
Shanghai. Teleg. matl.	17	0
Singapore. Telephone	25	0
„ Teleg. apps.	700	0
Sydney	253	0
St. Vincent	14	0
Wellington	25	0
„ Teleg. matl.	2,449	0
	6,859	0

Week ending May 1st, 1896.	£	s.
Adelaide. Teleg. matl.	1,210	0
Amsterdam	90	0
Antwerp	20	0
Bombay	35	0
Calcutta	409	0
Cape Town	633	0
„ „ Telph. stores	59	0
Colombo	66	0
Cologne	75	0
East London	50	0
Gibraltar. Teleg. apps.	36	0
Hong Kong	10	0
Malta. Teleg. material	692	0
Mauritius. Teleg. matl.	120	0
Melbourne	236	0
Odessa. Teleg. material	333	0
Revel	31	0
St. Helena	84	0
St. Petersburg	50	0
„ Teleg. matl.	51	0
Santos	89	0
Singapore	13	0
Sydney	192	0
	4,584	0

Foreign Goods Transhipped.

	£	s.
Antwerp	20	0

Price Lists Wanted for Johannesburg.—Messrs. Swete & Baker, electrical engineers, Box 647, care of Wm. Bettel, Gold Fields Hotel, Johannesburg, ask us to state that they will be glad to receive latest price lists of electrical plant, cables, fittings, &c., from manufacturers, quoting best terms for cash and best export discounts, as they will shortly be carrying out an important contract at Johannesburg, and also in Rhodesia.

Our Trade with South Africa.—The events of the past six months in South and Central Africa, coupled with the presence of Mr. Chamberlain at the Colonial Office, have opened the eyes of the British public—British manufacturers and traders in particular—wider than ever before to the large demand for home manufactures which the mining districts of that vast country must create as they are developed. Never before have the affairs of the "Dark Continent" been brought so closely in touch with the mother country as they have recently been. Every new item of interest regarding those parts has been eagerly devoured by the British employer and the British workman alike, and it is probable that that interest will grow as time goes on. The effect upon the British manufacturer has or will probably be to lead him to take steps to aid in that development by pushing, with untiring energy, his own wares upon that market and to that end be represented upon the spot. It is likely some may be waiting for the suppression of the rebel blacks, but that seems now assured, and, as affairs will shortly be quietly settled down, to be represented by a thorough-going business man will, we feel, be the aim of many a British house. Our friends across

the Atlantic make a great deal of extreme pushing in securing business, and while we would not recommend houses on this side to copy them in certain points, yet we do think if Great Britain is to hold her own against the States and others in Colonial trade, there must be more of this indomitable energy, push and hard work, which know no failure or defeat. There seems no reason why an additional turnover of millions sterling per annum should not be secured in England alone. Some of our leading electrical manufacturers have executed some good contracts for South Africa, but there should, and no doubt there will, be a great deal more done shortly. That our trans-Atlantic confrères are working there is again evidenced by a statement made by our New York namesake, to the effect that eight car-loads of electric pumps were recently shipped by an American electric manufacturing company to South Africa for use in gold mines. In one case electric pumps, arranged in series, will lift water from the bottom of a shaft 2,500 feet deep.

Since writing the above, we have come across an article in the *British and South African Export Gazette*, by Mr. H. H. Painter, A.M.I.C.E., on "Electrical Work on the Rand." We have not sufficient space at our disposal to reproduce it in full, but we would recommend those doing or contemplating business with those parts to read it. The following extracts from one of the closing paragraphs are of particular importance:—"Electrical engineers have all suffered more or less at the hands of the manufacturers. Situated at such an immense distance from the works, it is of the utmost importance that their directions should be most minutely carried out, and that the most careful tests should be made of all machinery before shipment. Unfortunately, it appears to have been the practice with some makers to keep their defective machines for the Colonies and abroad, and in many cases dynamos have been sent to Africa which would never have been supplied in England. This evil is now diminishing, but it has been a very great one, and has placed engineers in a most awkward position on many occasions. . . . . Defective and unsuitable packing especially in the past, when wagon transport was necessary, has been the cause of numerous breakages, and the non-adherence of manufacturers to their own specifications, has, in many cases, been an intolerable nuisance."

Action against the Central London Railway.—An action against the Central London Railway Company for compensation for freehold premises at 15, Argyll Street, Oxford Street, W., required for the construction of the Oxford Circus Railway Station, came on at Westminster on Saturday before the Deputy High Bailiff and a jury. The jury assessed the compensation at £8,085. The plaintiff was the Rev. C. G. Anderson.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court held last Friday, before Mr. Registrar Brougham, Walter Northcote Naylor, late of 481, New Cross Road, was allowed to pass his public examination upon accounts showing debts, £379 10s. 10d., and assets, £25 5s.

Business Amalgamation.—In our issue of January 31st, we notified that an amalgamation had been effected between the Nalder and Harrison Construction Syndicate, Limited, and Swinburne & Co., Limited. For the purposes of this amalgamation it has been found advisable to dissolve the Syndicate, and the amalgamated businesses will be in future carried on as a private firm under the title of Messrs. Nalder and Hilton, who have purchased the two businesses. This arrangement is to date from March 1st, 1896, and a special resolution for the above mentioned voluntary liquidation of the Syndicate has been passed. It is confidently anticipated that the combination of interest and the concentration of the business will be of great advantage to the firm and to their numerous clients.

Dissolution of Partnership.—Messrs. F. Catt and H. E. Hall, formerly carrying on business as electrical engineers at New Wharf, Tonbridge, have dissolved partnership by mutual consent. Mr. H. E. Hall will attend to the debts of the late firm.

Electric Current Bill.—Before the Lord Mayor the other day, Mr. H. Wildey Wright, barrister, Goldsmiths' Buildings, Middle Temple, was summoned at the instance of the City of London Electric Lighting Company for the non-payment of £4 15s. 2d. for electric light supplied. Defendant's clerk appeared and admitted the claim. An order was made for the payment of the amount, with the costs of the summons.

Small Incandescent Lamps.—The Sunbeam Incandescent Company, of Chicago, Ill., U.S.A., has been successful in perfecting an incandescent lamp filament, which enables it to make a 4-C.P. lamp of less than 20 watts energy consumed per lamp, and of from any voltage from 50 to 120; consequently, they can be connected in multiple to the regular lighting circuits and furnished with bases to fit all of the standard sockets. We understand that the Sunbeam Company is selling a good many of these in America, it being the only lamp of the kind manufactured in that country, and it claims to have already executed a number of large orders for shipment to foreign countries. In a circular that we have seen in reference to this lamp, it is stated that its principal purpose is for decorative lighting and for use in signs, the claim being made that with the lamp of small candle-power the sign is actually found to be more distinct at a distance, as it is not so much blurred as with a lamp of larger candle-power, and it is a much better lamp, not considering the great saving made in energy. We have often said in these columns that if a small and fairly efficient lamp were properly introduced to the public, there are many places where they could be advantageously used. The lighting of passages, staircases, &c., could often be done by much smaller lamps than the ordinary 8-C.P.

The Crystal Palace Show.—The British Aluminium Company, Limited, is making a large display at the Autocar Exhibition at the Crystal Palace.

Liquidation Notices.—A general meeting of the members of the Boy Messengers and Electric Call Company is to be held on June 22nd at 2 o'clock p.m. at the offices of Messrs. Jackson, Pixley & Co., 58, Coleman Street, E.C., for the purpose of having an account of the winding up laid before them.

ELECTRIC LIGHTING NOTES.

Aberdeen.—On Tuesday last the recommendation of the Electric Lighting Committee that the electric lighting station be extended at a cost of £4,500, and new boilers obtained at a cost of £3,000, was before the Council.

Alderley Edge.—A new company has just been formed at Alderley Edge which is known as the Alderley Edge and Wilmslow Electric Supply Company, Limited. It has been registered with a capital of £30,000. The company has been formed for the purpose of securing the provisional order which was recently obtained by the Alderley Edge District Council. When this has been transferred the company intend to supply Alderley Edge and the surrounding district, the company having secured land in Alderley for a generating station. It is proposed shortly to apply for a provisional order for the district and Wilmslow.

Bath.—We learn that the Lighting Committee has unanimously recommended the Town Council to purchase the plant and buildings of the Bath Electric Light Company at £24,533, excluding the arc lighting plant, lamps, and lamp-posts. The amount is based on the valuation of Prof. Kennedy. He does not think the Corporation should be compelled to purchase the arc section, and reports that the street lamps are obsolete, and of no value. In the event of the Corporation taking it over, the estimate would be increased by £1,954. The Committee's recommendation was to be laid before a special meeting of the Urban Sanitary Authority yesterday.

Battersea.—The Board of Trade has decided to grant a provisional order to the Battersea Vestry, authorising them to supply electricity within the area of their jurisdiction. The order authorises the expenditure of £50,000.

Belfast.—The engineer, Mr. Cowan, reported again the other day on the sites prepared for the new electricity station.

Bristol.—The Town Council has now sanctioned the expenditure of £75,000 upon electric lighting extensions, to which we have already referred. In moving the voting of this money, Mr. Pearson said the committee proposed to divide the expenditure into three yearly instalments, but it might be necessary to continue the whole of the building in the first year. In 1896 they proposed to spend £5,000 in putting in foundations and continuing the river wall, &c., and in 1897 they proposed to spend £3,000 more upon building, and they would then have to spend on machinery £11,500. In 1898 they contemplated spending on building a further sum of £8,000, and about £7,600 for further machinery. In 1899 the building being complete and properly equipped, a further expenditure of about £5,700 would be necessary, and in addition it was their intention, if the demand arose, to put in a direct current plant, at a cost of about £5,000, which would give them about 250 horse-power. They would also have to main the streets under contemplation, and to do this it was estimated they would require something like £16,000. This would not be done straight off, but as the demand arose. In addition they would want some money for contingencies, and it was estimated that about £4,000 would be needed. For making connections they would require something like £8,000. The total estimated expenditure was £74,735, upon which the committee thought they were doing right in coming there and asking to be allowed to raise a loan of £75,000. The Sanitary Committee has been requested to report as to the extension of electric lighting in the public streets.

Burnham (Essex).—A contemporary says that Messrs. Donnison & Co., of London, have started a movement here for establishing an electric lighting installation.

Canterbury.—The Council has decided to adopt the electric light, and has appointed an engineer to prepare plans for the necessary works. Application is to be made to the Local Government Board for a loan of £20,000. It is expected that the Cathedral will be one of the first buildings in the city to be illuminated by electricity.

Chelmsford.—The *Financial Post* says that the negotiations which have been proceeding between Messrs. Crompton & Co., Limited, and Chelmsford Town Council for the transfer to the latter of the company's electric lighting provisional order and new works in Chelmsford have not yet been brought to an issue. The company have offered to dispose of their undertaking for £34,828, but before coming to a decision on the matter the services of an expert are to be requisitioned to advise the Council on the subject.

Cheltenham.—The minutes of the Electric Lighting Committee which were adopted on 5th inst., state that the electrical engineer was authorised to order the cable required for the Bath Road extension and street lighting of the Promenade and High Street, and an additional Galloway boiler, contingent upon the sanction of the Local Government Board being received to borrow the money required, and that consideration of the question of increasing the pressure of supply in outlying districts from 100 to 200 volts was adjourned.

Chelsea.—The London County Council has approved the plans submitted by the Chelsea Electricity Supply Company for the construction of a generating station on the west side of Flood Street, Alpha Place.

China.—The electric lighting company at Hong Kong is reported to be at present considering the question of putting down additional plant.

Devonport.—In the House of Commons last week, the Devonport Electric Lighting Bill was read a third time.

Eccles.—A Local Government Board inquiry is to be held shortly regarding the Council's application to borrow money for electric lighting purposes. Two new councillors have just been elected, who are stated to be pledged to oppose the electric light.

Exeter.—The governors of the Devon and Exeter Hospital have had under consideration a recommendation from the committee to adopt the electric light. It was stated that the machinery and apparatus required for the new laundry could also be used for generating electricity. Messrs. Veale & Co., St. Austell, estimated the cost of installing the light at £896; but it was estimated that contingencies would bring the total up to £1,195. The medical staff are in favour of the electric light. The cost of working will be about £190 a year, or £50 less than the cost of gas. But it was pointed out at the meeting that there will also be a saving in painting and whitewashing, to the extent, it is thought, of nearly £200 a-year. The committee's proposal to adopt the light, as also another to obtain £1,000 to carry on the installation, were carried by 22 votes to three.

Fulham.—The report prepared by Mr. Medhurst *re* electric lighting and dust destructor is not to be considered until the new Vestry is in office.

Glasgow.—The Corporation has remitted it to the Watching and Lighting Committee to consider what equitable means could be devised for the improvement of the general lighting of the city, and report.

Halifax.—The Gas Committee of the Corporation are making arrangements for holding an exhibition of electrical appliances at Northgate Hall in about a fortnight. The exhibits will include electric motors, heating and cooking apparatus, &c.

Hammersmith.—Plans for the electric lighting station have been approved by the Vestry.

Hotel Cecil.—In connection with the opening of the new Hotel Cecil, the whole of the indoor arrangements in connection with the installation for upwards of 6,000 electric lights, telephones, and electric system of ventilation, has been carried out under the supervision of Mr. Morgan Williams, C.E. The electric light is at present obtained from the Charing Cross and Strand Electricity Supply Company, but will eventually be served by the hotel's own plant, erected under the supervision of Mr. Robert Hammond. The contractors for the whole of the electric work are Messrs. B. Verity & Sons. The Blackman Ventilating Company fitted their electric fans in the grand dining, smoking, coffee, and billiard rooms. They are placed in the windows for the purpose of drawing fresh air into the rooms, and forcing out that which is vitiated. The fans in the dining rooms are capable of dealing with nearly one million cubic feet per hour, and those in the coffee and billiard rooms about half a million in each case. The lavatories are also ventilated by Blackman electric fans in a similar manner, the vitiated air being forced through a duct above the top of the building.

Hull.—The Electrical Engineer's report with reference to the extension of the electric lighting system from Ocean Place to near Midland Street has been adopted by the Corporation.

Islington.—The following is an abstract of the Electric Lighting Committee's report on necessary extensions, which was before the Vestry on 1st inst.:—The Committee recommend (*a*) That it be referred back to the Committee to at once take steps for placing orders for the additional plant mentioned in the report of the electrical engineer, and for the necessary extension of the station to accommodate such plant, at an estimated cost of £23,750, so that if possible such plant may be available for running during the ensuing winter. (*b*) That conduits and mains be at once laid in the Holloway Road, from the "Nag's Head" public house to the "Archway" Tavern, at an estimated cost of £5,000. (*c*) That conduits and mains be at once laid in the Caledonian Road at an estimated cost of £9,000, several applications for a supply of current having been received from occupiers in that road, including a requisition for current in the Wharfdale Road and neighbourhood, equivalent to 3,000 8-C.P. lamps. (*d*) That the consideration of the question of the suggested extensions along the Essex and Camden Roads be deferred for the present. Mr. Gay, the electrical engineer, has gone carefully into the cost of extending the mains on both sides of the Caledonian Road, Camden Road, Essex Road, and the completion of the Holloway Road from the "Nag's Head" public house to the "Archway" Tavern. This includes pipes and mains for the street lighting in all cases; lamp columns, lamps and fittings, and all accessories, as well as labour and re-laying. The cost of this for the different streets is as follows:—Caledonian Road, £8,796; Camden Road, £4,035; Essex Road, £6,549; Holloway Road, £4,914; total mains, £24,294. To this must be added the estimated cost of engines, alternators, boilers, &c., as follows:—Two 300-kilowatt alternators, two exciters and accessories, say £5,000; four Lancashire boilers and accessories, say £2,750; two 500 horse-power engines and accessories, say £6,000; contingencies, steam-pipes, &c., say £1,500; meters, transformers, low tension mains, and accessories, say £3,000; total, £42,544; extension of buildings, in accordance with architect's estimate, £5,500; grand total of £48,044.

Lambeth.—As we anticipated, the Lambeth Vestry has decided, by 44 votes to to 15, to transfer the provisional order held by them from the Board of Trade for the electric lighting of the district to Mr. C. W. Sax. As a guarantee for the carrying out of the contract, which represents a sum of £400,000, Mr. Sax will deposit with the vestry £5,000. The current will be supplied at 6d. per unit, and the whole of the mains are to be laid within two years.

Leyton, Essex.—The work of laying the conduits for the electric light mains is being rapidly proceeded with by Messrs. Siemens. The whole of the conduits will be on the Doulton system.

Liverpool.—Messrs. Grindley & Palmer's picture galleries, at Church Street, Liverpool, have lately been renovated, and a new electric light installation has been fitted there by Mr. Charles Rettie. The old installation, which only consisted of a very few lights, has been replaced by an entirely new plant consisting of 119 lights. The installation is divided into four main sections, which are divided again into several small sections, each being distinctly separate. The whole are controlled by two D.P. switches, 50 amperes and 25 amperes respectively. There are also six sectional 25 ampere switches, as well as a small switch, to every light or cluster. There are three large switchboards. All the fittings were specially designed by Messrs. Grindley & Palmer and Mr. Rettie.

Lurgan.—*Daily Tenders and Contracts* says that the Town Commissioners have under consideration a scheme for the electric lighting of the streets, at a cost of £500.

Malta.—The main streets of Valetta are fitted with the electric light, and when it was turned on a short time ago, the results were deemed very satisfactory.

Manchester.—The great success of the electric lighting installation here has, as might be expected, necessitated again very considerable extensions. The County Council, on Wednesday, had before it a proposal to spend £100,000.

Middlesbrough.—On 29th ult. the Electric Lighting Committee considered a report from Mr. Hammond in favour of electric lighting for the town. He recommended an installation costing £21,000. The Committee negatived the recommendation by eight votes to two.

Morley.—The *London Gazette* contains notice of the electric lighting license for which the Corporation is applying to the Board of Trade. Queen Street, Chapel Street, and Church Street are to be the first thoroughfares lighted.

Newington.—The Board of Trade has advised the Vestry that after considering the report of their inspector who held the recent inquiry at Newington, they do not propose to proceed with the application, nor with the provisional order lodged by the County of London and Brush Company. The Vestry has written to the Board of Trade in reply, to the effect that it is prepared to give effect to a provisional order if granted, subject to the engineer's report being satisfactory. The company referred to have written to the Vestry, offering to pay the reasonable expenses of the Vestry in connection with their application for a provisional order, upon condition that consent was given to the Board of Trade to proceed with the company's order for Newington. The Vestry resolved to respectfully decline this offer, "as it intends to continue its opposition to any company coming into the parish, and to obtain the order for itself."

Newport.—The provision market is now electrically lighted by means of two arc lamps and about 250 incandescent lights.

Oxford.—Owing to the rapid increase in the number of lamps connected to the Oxford Electric Company's mains since the beginning of the year, it has been deemed advisable to considerably increase the generating power, and acting on the advice of their engineer, Mr. J. Hardie McLean, M.I.E.E., the directors have decided to increase the size of unit, and an order has been placed with Messrs. J. & H. McLaren, of Leeds, for a 500 indicated horse-power triple-expansion surface condensing engine, and a 260-kilowatt dynamo from the Electric Construction Company, of Wolverhampton. Up to the present, 100 and 80 unit dynamos have been in use. Messrs. McLaren have guaranteed a steam consumption of 13¼ lbs. per indicated horse-power, so that the excellent results which have been obtained at Oxford for economy should be well maintained. The dynamo will be driven off the fly-wheel of the engine, by means of 17 5-inch ropes, the engine fly-wheel being 12 feet diameter. The engine will be fitted with McLaren's patent adjustable automatic expansion governor. This governor has proved to be thoroughly reliable. The high pressure and low pressure valves will be balanced. The capacity of the station will be raised from 19,000 to 33,500 8-C.P. lamps connected.

Paddington.—The Vestry has been considering whether to light the Workhouse Chapel and wards by electricity. The matter has been adjourned for six weeks for a scheme to be brought forward.

Peterborough.—Electric lighting had a narrow escape at the last Council meeting. Councillors went thoroughly into the question, the motion before the meeting being that it is undesirable to proceed at present with the application for a loan of £20,000 for electric lighting purposes. The result of the discussion was that the motion was lost, 11 voting in favour and 12 against.

A Local Government Board inquiry was to be held on Wednesday.

Stockton.—A deputation, which has visited other towns, recommends the Council to provide an installation on the low tension system, at a probable cost of £16,000 or £18,000. A further extension of time is to be applied for.

Hospital Lighting.—Ruchill Hospital, Glasgow, is to be lighted by electricity, a special installation being laid down. A Glasgow councillor thought the supply should have been taken from the Glasgow Corporation station.

Shoreditch.—A communication from the "Federated Trades' Union of Labourers employed in the Building Trades," asserting that all their members were to have their wages raised ½d. per hour on and after May 1st, had a very warm reception at the last Vestry meeting. The Vestry decided to enter the letter in the minutes as received, but to take no further notice of the high-handed demand. This move will affect the Electric Light Committee in relation to the erection of the electric lighting buildings, more than any other section of the Vestry. The underground work in connection with the Vestry electric lighting scheme is now in hand, the British Insulated Wire Company having commenced to lay the Doulton conduits, which will be used for the entire system of mains.

Thames Embankment.—During the discussion of the County Council annual estimates, a question was asked as to the position of the scheme for the electric lighting of the Victoria Embankment and Westminster and Waterloo Bridges. In reply to the question, Mr. Westacott stated that the matter would probably be considered at the next meeting of the Highways Committee, who would then bring up a report.

The Electric Lighting in the Royal Navy.—The arrangements for the electric lighting of H.M.S. *Hannibal*, the first class line of battleship which was launched at Pembroke last week, will be most complete. She is to be fitted with three dynamos, each of 400 amperes and 80 volts. The installation will require about 900 incandescent electric lamps, and the ship will, in addition, carry three search lights, each of 30,000 candle-power.

Torquay.—The Local Government Board has notified its intention to hold an inquiry *re* electric lighting loan, as soon as possible.

Wakefield.—A Bazaar has just been held in the Corn Exchange to raise funds for various purposes, including the introduction of the electric light into the Cathedral.

Worcester.—A Local Government Board inquiry was held on 5th inst., *re* application of the Corporation for power to raise a £6,580 loan for electric lighting.

Woolton.—Messrs. Drake & Gorham have secured the contract for the electric lighting of Capt. Wingfield Stratford's country house at Woolton, by means of a separate plant.

Wilmslow.—The District Council has discussed the question of providing for the expense of an electric lighting provisional order, and it has decided to provide for this in the estimates to the extent of £200.

York.—The City Council has adopted the recommendation of Prof. Kennedy and the Streets and Buildings Committte respecting electric lighting, and has requested the professor to prepare a specification with a view to inviting tenders for the necessary plant.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Baker Street and Waterloo Electric Railway.—Mr. Parker Smith, who presided over a recent meeting of the Commons Committee on unopposed Bills, has reported in respect of the Baker Street and Waterloo Railway Bill, which duly passed the Committee, that by Clause 49 of the measure, it is proposed to authorise the payment of interest out of capital during the construction of the railway upon the capital authorised by the Bill, and by the Baker Street and Waterloo Railway Act, 1893. It was proved to the Committee that the power to pay interest during its construction would tend to facilitate the raising of the capital authorised by this Bill, and by the Act of 1893. The Committee found that the restrictions contained in the clause were in accordance with Standing Order No. 167, and recommend that payment of interest as proposed by the Bill should be allowed.

Belfast Tramways.—A deputation from the Trades Council waited upon the Corporation the other day to bring before them the necessity of increased tramway service in certain districts, and to ask the Corporation to lay the lines themselves, as the first step to their acquiring the whole service, and to get the Tramways Company, which owns the existing lines, to work the new sections. This meeting was an adjourned one for considering the Bill which was being applied for by the Belfast Street Tramways Company, and which included powers for running by electric traction. The statements of the deputation having been heard, also the remarks of the company, there was a lengthy and general discussion, after which further consideration was adjourned for a month, the Town Clerk meanwhile to look fully into the matter.

Electric Railway Statistics.—The position of this country—compared with France and Germany—in regard to traction matters, is shown in the following table recently given in *L'Industrie Electrique*:—

Countries.	Length of track, kilometres.	Power in kilowatts.	Number of motor cars.
Germany	406·4	7,194	857
England	94·3	4,243	143
Austria-Hungary	71·0	1,949	157
Belgium	25·0	1,120	48
Bosnia	5·6	75	6
Spain	29·0	600	26
France	132·0	4,490	225
Holland	3·2	320	14
Ireland	13·0	440	25
Italy	39·7	1,890	84
Sweden and Norway	7·5	225	15
Portugal	2·8	110	3
Roumania	5·5	140	15
Russia	10·0	540	32
Servia	10·0	200	11
Switzerland	47·0	1,559	86
Total	902·0	25,095	1,747

Another table shows that the tendency is decidedly in the direction of the overhead trolley:—

Countries.	Roads with overhead conductors.	Conduit roads.	With central rail.	With accumulator.	Total number of roads.
Germany	35	1	...	...	36
England	7	1	8	1	17
Austria-Hungary ...	6	1	...	2	9
Belgium	3	...	...	...	3
Bosnia	1	...	...	...	1
Spain	2	...	...	...	2
France	11	...	1	4	16
Holland	...	...	...	1	1
Ireland	1	...	...	...	1
Italy	7	...	...	...	1
Sweden and Norway	1	...	...	...	1
Portugal	1	...	...	...	1
Roumania	1	...	...	...	1
Russia	2	...	...	...	2
Servia	1	...	...	...	1
Switzerland ...	12	...	...	...	...
Total	91	3	9	8	111

The New York *Electrical Engineer*, referring to the accumulator systems given in the table, says that, considering the popularity of the storage battery for stationary purposes, it is somewhat disappointing to find but three or four roads which have adopted them in the stations as load equalisers, "but that this will follow in due course we have not the slightest doubt." Our contemporary concludes its article by giving a few statistics of the street railways in the U.S., as follows:—

Length of track, electric roads	miles	10,363
" " horse roads	"	1,914
" " cable roads	"	632
" " miscellaneous roads ...	"	679
Number of cars, electric	...	24,745
" of roads, electric	...	976

The statement that "in Pittsburgh a cable plant that has cost over $10,000,000 is about to be ripped out to make way for electricity" should be considered by the Corporation of Edinburgh, and other British towns, where cable tramways seem to be very fascinating.

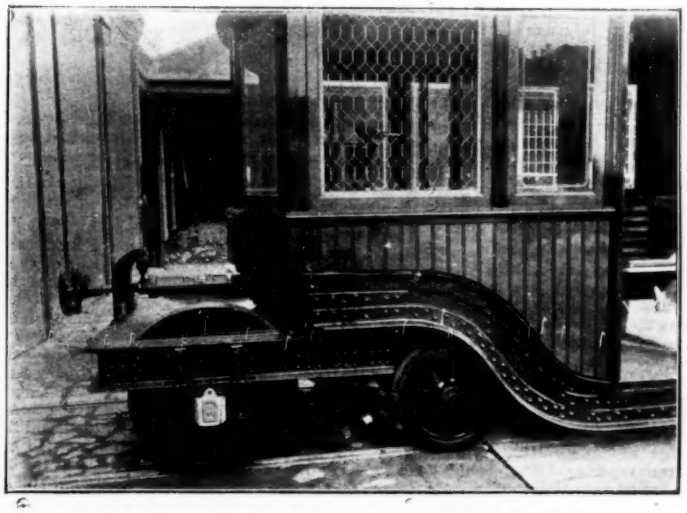
Bristol Electric Tramways.—"It is stated on good authority," says the *Bristol Mercury*, "that the Electric Light Committee intend to persist in their demand that in any extension of the electric traction in the city—after the Eastville section from Trinity Church has been completed, as this will be excepted—the Corporation shall supply the power to the company. The Committee say that as a mere incident in their arrangements, after they have carried out their proposed extension of the electric lighting station and plant at a cost of £75,000, they can supply 1,000 horse-power, and provide sufficient to drive all the trams in Bristol at practically no further outlay beyond one or two additional dynamos. This will mean a block to all further electric traction in the city, however much it might be desired, as the company are very firm in their determination not to admit of any such divided authority in the administration of their extensive system of tram service, now so largely used by the whole population of the city." We can hardly believe that the Committee will long persist in such a demand.

Dover Electric Tramways.—A member of the Council intends to move that a deputation visit Rouen and other places to inspect the electric tramways.

Douglas Upper Town Tramway.—The Act confirming the agreement between the Douglas Town Council and the Douglas Bay Electric Tramway Company, for the new lease of the Bay line, on terms which included the construction of a cable tramway to Upper Town, imposed the condition that the double lines were to be laid on each side of the thoroughfare through which they passed. A section of the new line has been constructed on one side of Bucks Road; but what would have been the ordinary cost of the line has been so much increased by the necessity of removing the gas and water mains from under the line, that the company made an application to divert the double lines to the centre of the roadway for the remainder of the distance. The Attorney-General and Mr. Ring were of opinion that the Act empowered the Council, with the approval of the Lieutenant-Governor, to divert the lines from the sides to the centre of the roadway. The opinion of Mr. Kneen, the legal adviser to the board, was in opposition to that of the advisers of the company; but assuming that they were right, and that the Governor approved the alteration, he thought the board would not run any real risk under the circumstances. The Council has agreed to grant permission for the deviation, subject to the approval of the Lieutenant-Governor, and to the company undertaking to indemnify the Council against all liability. Immediate application will be made to the Governor in Council for his sanction to the deviation. If obtained, it will mean, we are told, a saving of from £10,000 to £15,000 on the laying of the lines.

Electric Traction in Spain.—It is proposed to convert the tramways in the town of Zaragosa into electric lines.

The Underground Railway at Buda Pesth.—This line has been constructed under the residential streets of Buda Pesth. The whole track had to be done on the cut and cover system, and its cost was over 1,000,000 florins per km. The line is double track throughout, and will be opened for traffic, it is believed, next month. The stations are only 400 metres apart, and it is intended to run the cars at a maximum speed of 40 km. an hour. A novel system of speed regulation has been adopted, the object of which is to do away with the necessity for any intelligence on the part of the motorman. The motorman can only cut the motors in and out, but cannot regulate their speed, this being done automatically. A solenoid is connected to the brush terminals of the motor on the car, and as the counter electromotive force increases, so does the magnetism of the solenoid. The device is extremely ingenious, and it can be regulated in such a way as to practically fix the distance in which the car will attain its maximum speed. Electric brakes are also used, similar to the Sperry brake now adopted by the General Electric, of America. There are two motors on each car, they also being used for braking by short-circuiting them, and making them work as generators. The height of the tunnel from the top of the rail is 2·85 metres; the tunnel could not be made any higher, as otherwise it would have been lower than the level of the Danube, and that would have increased the expense of construction enormously. The cars have been specially built; each car is mounted on two bogies, and inside they are exceedingly handsome, and look more like the saloon of a yacht than a tram car. There are 29 seats, and there is room for 15 to stand up. The total weight of a car when empty is 12 tons. One 50-horse-power motor is mounted on each truck. The line was built and equipped by Messrs. Siemens & Halske, of Berlin. The current is taken from an overhead conductor, which is fixed to the roof of the tunnel by means of cast-iron shoes. The tunnels and the stations are all lined with glazed tiles. The line was constructed with the object of connecting the system of tramways which encircles Buda Pesth with the centre of the city. Tramways were not possible, as the town authorities would not allow any rails to be laid down along the streets of the residential quarters through which this line would have had to pass.



One of the Cars on the Underground Railway at Buda Pesth.

Coventry Tramways.—In accordance with agreement made in April, 1893, between the Corporation and Mr. Graff Baker, a certificate has been prepared showing the cost of the purchase, improvement, reconstruction, and equipment of the Coventry and District Tramways upon the system of electric traction. The certificate was practically for the purposes of valuation in the event of the Corporation purchasing the tramways. The cost arrived at was £34,960.

West Hartlepool Electric Tramways.—Another satisfactory trial of the cars on this line took place on 30th ult.

The Central London Electric Railway.—The Electric Traction Company, Limited, of Great George Street Chambers, S.W., who are the contractors for the construction of the Central London Railway from Shepherd's Bush to the Bank, have accepted the following sub-contracts for the construction of the tunnels: Shepherd's Bush to the Marble Arch (Sections 1, 2 and 3), Mr. John Price, of Westminster; Marble Arch to the Post Office (Sections 4 and 5), Messrs. Walter Scott & Co., of Newcastle; the Post Office to the Bank (Section 6), Mr. George Talbot, of Glasgow. The work on all these sections will be commenced early in July, and completed about October, 1897.

Blackpool Tramways.—The Blackpool Corporation (Improvement) Bill, which will enable the Corporation to run their Tramways, and the Blackpool, St. Anne's, and Lytham Tramways Bill, which seeks to revive the powers and extend the time for the completion of the tramways authorised by the 1893 Act, have been passed by the Commons Committee.

Electric Cranes.—As the new electric cranes for the Town Quay are required to lift 3 tons, but usually working at 30 cwt., the engineer has informed the Harbour Board that they will cost £100 more than was at first estimated.

South African Power Notes.—We derive the following information regarding the uses of electricity for power purposes in South Africa from the *British and South African Export Gazette*:—Four electric locomotives are on order for tramming in the drives of the north vertical shaft on the Simmer and Jack mine. The same principle will, we believe, be introduced in the drives of all the associated Simmer and Jack properties.—The electric power for the pumping plant on the May Consolidated Mine will be transmitted from a Siemens & Halske generator, driven by an 80-H.P. Willans and Robinson engine.—The erection of a large central electrical power plant at the Rand Victoria shaft, on the Simmer and Jack property, which will be the largest of its kind on the Rand, is, we believe, now being considered by the management. If the plan is carried out, the total horse-power of the plant will be about 3,600.—The electrical installation for generating power and light on the Lancaster mine will be on the three-phase system. A novel feature of the installation will be that every tool in the workshop will be driven by a motor.—Messrs. Reunert & Lenz, Johannesburg, have entered into a contract with Moodie's Company to substitute their triphase (alternating current) system for the present installation, which will provide power for 200 stamps. Water-power will be used, but with new motors.—The Westinghouse Electric and Manufacturing Company, Pittsburg, U.S.A., are supplying the electric motors and railway generators for the Cape Tram Company.—The cyanide plant on the May Consolidated Mine has been increased to a capacity of about 12,000 tons per month. The process adopted is that of Siemens and Halske. It consists of seven setting vats of 200 tons capacity each, 10 leaching vats of similar capacity, and four solution vats.—The mill-house on the Roodepoort Deep is fitted with two of Willans 240-H.P. central valve compound condensing engines, which generate all the electric power required on the mine.—The three-throw electric pump, capable of delivering 20,000 gallons per hour, which has been erected at the new reservoir on the May Consolidated Mine, is to be supplemented by one of a similar pattern, now on order, capable of delivering 40,000 gallons per hour.—The pumping on the Bantjes mine, and any underground hoisting which may be required hereafter, will be done by electricity.—A 6-inch three-throw electric pump will be erected shortly at the new fresh water dam on the Ginsberg mine.—The cables have been erected for the transmission of the necessary power to work the electric pumps at the new water dam on the May Consolidated Mine.—A 20-H.P. Armington-Sims engine drives the power required for the electrical precipitation, and three centrifugal pumps for water and solutions on the May Consolidated property.

Dublin-Dalkey Electric Trams.—The Dalkey electric tramway is now completed, and only awaits the Board of Trade inspection in order that it may be opened for traffic. The official examination was to take place yesterday, and then, without further delay, the tramway will be ready for public service.

Printing by Electricity.—The *Aberdeen Free Press* is now printed by a Hoe machine driven by electricity. A couple of electric motors, having a capacity of 50 H.P., are supplied with current from the Corporation mains.

Electric Traction in Switzerland.—The company known as the Zurichbergbahn is increasing the capacity of its central power station in Zurich by the addition of two Crossley gas engines, one of 120 H.P., and one of 12 H.P. The latter is intended for use in connection with the charging of the accumulators.

Glasgow Tramways.—The Sub-committee on Mechanical Tramway Traction is to visit Coventry, Bristol, and Hamburg, before considering the report to which we referred last week, and before making any report to the Tramways Committee or to the Corporation.

Organ Blowing.—The *Kidderminster Times* contains a short description of the new organ in Worcester Cathedral, which is to be operated by electricity on the Hope-Jones principle.

TELEGRAPH AND TELEPHONE NOTES.

Australian Landlines.—The frequent interruption and delays on the Australian trunk landlines have apparently at last indicated the necessity for a more efficient service. At present, we understand that a duplicate landline is in course of construction between South Australia and Albany (in the south of Western Australia). This landline, beginning at Port Augusta to the north of Adelaide, runs westward to the south of the Gawler range, following pretty much the line explored by Stuart in 1858, till it reaches Streaky Bay, on the west coast of Eyre Land, from whence it runs along the coast to Eucla. It is expected that the section between Flagstaff Landing and Eucla, about 380 miles, will be completed by October next. This duplication is all very well as far as it goes, and doubtless experience has shown that the line running northward along the coast of Western Australia to join the Roebuck Bay cable is quite unreliable, and it would therefore seem advisable, in view of the heavy traffic, to insure the Coolgardie telegrams reaching South Australia without delay; but, in carrying out such a duplication, it must be borne in mind that the South Australian landline which connects with the cables at Port Darwin, is not itself all that could be desired. It is a question worth serious consideration whether the money to be expended in duplicating and rendering efficient the landlines above referred to, had not better be capitalised, and a portion of the interest thereon be devoted to the subsidies necessary for the construction of the Pacific cable, which is generally admitted to be the only sufficient alternative to the existing system.

Bath Telephone Service.—The National Telephone Company wants to lay underground mains for trunk lines in certain streets in the City. The Surveyor is to report on the matter to a Sub-Committee.

Cables to South Africa.—During the critical state of affairs in South Africa following the Transvaal trouble, a great deal of anxiety was caused by the dearth of telegraphic news, owing to the succession of breakdowns of the cable system to South Africa. At present the political outlook is still overcast, and it is, therefore, very unfortunate that the Loanda-St. Thomas cable was interrupted on the 2nd current. We pointed out, when dealing with this question on former occasions, the necessity (at least) for the duplication of the Aden-Zanzibar cable, and also the importance of establishing a line from the Cape to Sierra Leone *via* Ascension and the Island of St. Helena. This latter cable would, we are convinced, meet with the support of both the War Office and the Admiralty. An alternative route has been suggested which, running from Aden, should land at the Seychelles Islands, these connecting with the existing cable from Zanzibar; but this proposal, although it would be beneficial to the traffic account of the Eastern Telegraph Company, has the obvious disadvantage that the cables run through the Red Sea, Egypt, and Mediterranean, where, in case of greatest need, it could be interrupted. Besides this, we may point out that the cable route from Cape Town along the West Coast of Africa is about 2,000 miles shorter than the East Coast and Mediterranean route.

Communication with India and the East.—Last month we had to call attention to the fact that the Indo-European line was interrupted in the neighbourhood of Tiflis. We now learn that this route was again interrupted on the 5th current between Shiraz and Bushire. This line, as our readers may be aware, is looked on as an "alternative" to the existing cable route from England to India, Australia, and the East generally, and, we believe, fulfilled this condition satisfactorily on the occasion of the bombardment of Alexandria, when the lines across the Isthmus of Suez were at once cut, and remained interrupted from that date to the battle of Tel-el-Kebir, a period of about two months. It is very probable that the present interruption of the Indo-European route may be a consequence of political feeling in Persia, aroused by the assassination of the Shah. In a *Times* telegram from Teheran we read the following: "Shiraz was quieter last night. Four men were executed yesterday by order of the Governor, and further disturbances are unlikely, but the road and environs are unsafe." As Lieut.-Col. H. L. Wells, R.E., pointed out in a paper, "Telegraphs and Trade Routes in Persia," the people of Shiraz "are a high spirited, turbulent set," and "when a disturbance breaks out, the first point generally made for is the Persian telegraph office. The popular leader demands that a petition embodying the wrongs of the citizens shall be dispatched to the Shah. If a reply is not quickly forthcoming, the mob usually ousts the Persian telegraph officials and wrecks the office, or, at all events, renders the instruments useless. A move is then made for the British office, and a message is dictated to the superintendent, who has to forward it to the director in Teheran, who hands copies of it to her Britannic Majesty's Minister, the Grand Vizier, and the Persian Minister of Telegraphs, and consults with them with a view to obtaining protection for his staff." From the above we may conclude that, however useful the Indo-European route may be in an ordinary way, still, in times of political excitement and disturbance, it cannot be looked on as an "alternative" to the cable route, which itself is subject to similar objections—in short, the only useful and practical alternative to the existing lines is to be found in the establishment of a trans-Pacific cable.

Shoreditch Telephone Service.—The Telephone Company have asked the Vestry to allow them to lay their wires underground through Shoreditch at the same time as the Electric Lighting Committee has the ground open for laying electric lighting mains. Two committees are to give the proposal joint consideration.

Telegraphic Interruptions and Repairs:—

	Down.	Repaired.
CABLES.		
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
" " (P.Q.) ...	June 24th, 1895 ...	...
Brest-Penzance (P.Q.) ...	... ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Ceara-Maranham	April 28th, 1896 ...	...
San Thomé-Loanda	May 2nd, 1896 ..	...
Shanghai-Nagasaki	May 5th, 1896 ..	..
Amazon Company's cable beyond Monte Alegre	May 5th, 1896 ...	..
LANDLINES.		
Communication with Matagalpa Provinces of Leon and Chinandega	Feb. 26th, 1896 ...	...
Trans-Continental line beyond Mazol (Mashonaland) Telegrams for Tohikwawa and Blantyre cannot be accepted.	March 12th, 1896 ...	...
Saigon-Bangkok ...	April 29th, 1896 ...	May 1st, 1896.
	May 5th, 1896 ...	...
Indo-European lines between Shiraz and Bushire	May 5th, 1896 ...	...

Telegraph Wires Fired.—A fire which occurred at Burton-on-Trent, on Sunday, melted a network of overhead telegraph wires, numbering between 30 and 40.

The Gilgit Telegraphs.—An Indian paper states that telegraphic communication with Gilgit will be materially facilitated by the branch telegraph line to Kohala, which has just been completed.

Telegraph Rates to the Continent.—Mr. Henniker Heaton last week in the House of Commons asked whether, seeing that the telegraph rate from England to Spain is 4d. per word, and only 2d. per word from England to Germany, the Secretary to the Treasury would state when the concession of the cable company to Spain will expire; and if any measures would then be taken for the acquisition of the cable by the British Government, with a view to a reduction of the rate.—Mr. Hanbury said two companies had cables between England and Spain, the Direct Spanish and the Eastern. The license to land the cable of the former company on the shores of this country would expire in 1903, and the license for the cable of the latter in 1904. It was too soon to say what the action of Her Majesty's Government would be at the time in question.

The Pacific Cable.—From the *Times* telegraphic report of the electoral manifesto of the Canadian Premier we take the following:—"The two lines of steamers plying from Canada across the Pacific, the one to China and Japan, and the other to Australia, in conjunction with the Canadian Pacific Railway, have established the fact that Canada affords the best and speediest line of communication between the metropolis of the world and Australasia and the Far East respectively. The Imperial Government clearly grasps the importance of this fact, and has given tangible evidence of its desire to make the route more effective by affording direct financial aid to the Atlantic link of the chain, as well as to the service between Vancouver and the East. The laying of a cable across the Pacific is an essential complement to the transport facilities, and the Premier trusts that the coming conference in London may speedily settle the terms upon which that very important undertaking may be carried out."

United States Pacific Cable Scheme.—A Washington dispatch says that the Senate Committee on Foreign relations has agreed to the Bill for the construction of a United States-Hawaii-Japan cable, and authorises the Postmaster-General to contract with any company to lay the cable, the subsidy not to exceed $160,000 yearly. Mr. Faye reported to the Senate the action of the Foreign Relations Committee regarding the Pacific cable. The report declares that the Hawaiian cable is demanded by the exigencies of commerce. It refers to the importance of Pearl Harbour and the necessity for telegraphic communication with Hawaii to direct the operations of the Pacific Fleet in case of war. Moreover, in the event of the severance of peaceful relations with Great Britain, communications by way of Nova Scotia would be immediately cut off, and the United States would be dependent upon the cable from Brazil to Portugal. The cost of the cable is estimated at $3,400,000, and the maintenance at $516,000 yearly for the first five years. The Bill provides that the cable shall continue under the supervision of the Postmaster-General. The report contends that the contract secures for the United States better control than a mere grant, while giving an increased aspect of stability.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—June 1st. The municipal authorities of Prague are inviting tenders for the erection and equipment of a municipal electricity generating station in the town for electric lighting, power, and tramway traction purposes. Tenders are to be directed to the Stadrath der Haupt, Stadt Prague, Prague, Austria, from whom full particulars may be obtained.

Belgium.—May 27th. Tenders are being invited for the conversion into electric lines of about 20 kilometres of "Vicinal" steam railways in the Centre district. Tenders are to be sent to the Société Nationale des Chemins de Fer Vicinaux, 26, Rue de la Suencè, Brussels, where full particulars may be had for the sum of 1 franc.

Bray.—May 18th. The Town Council invites tenders for a boiler, alternator, fuel economiser, engine, &c., for electric lighting. For further details see our "Official Notices."

Bulgaria.—May 13th. The General Direction of the Bulgarian Posts and Telegraphs in Sofia is inviting tenders for the supply of a quantity of iron wire, bronze wire, iron hooks and insulators, of an estimated total value of £6,132.

Coventry.—May 12th. The Corporation invites tenders for the supply and erection of boilers and other plant for the boiler house, also steam engine, alternator, fittings, &c., for electric lighting. For further details, see our "Official Notices."

Hammersmith.—May 27th. The Vestry invites tenders for cables, pipes, arc lamps and lamp posts, transformers, sub-stations, and overhead travelling cranes. Mr. A. H. Preece is the consulting engineer. For further details see our "Official Notices."

Hampstead.—As soon as specification and details have been prepared by the architect, tenders are to be invited for the proposed additional buildings at the central station.

Italy.—In anticipation of the expiration of the gas lighting concession in 1898, the municipal authorities of Voghera, a silk manufacturing town in the province of the same name, are inviting tenders until the end of the present year for the concession for the electric lighting of the public streets. Tenders are to be sent to and particulars of the concession may be had from L'Amministrazione Comunale di Voghera.

Lima.—June 1st. The Municipal Council is inviting tenders for the establishment and working of the electric lighting in the squares and streets of the city, with power to work the private supply under a 20 years' contract. Particulars to be obtained at the Peruvian Legation, 13, Comeragh Road, West Kensington, W.

Portsmouth.—May 13th. Tenders are invited for wiring part of the main building of the workhouse for lighting by electricity, for the guardians of the Portsea Island Union. Particulars from the superintendent, Portsmouth Corporation Electricity Supply, Gunwharf Road.

Roumania.—May 12th. The General Direction of the Roumanian Posts and Telegraphs in Bucharest is inviting tenders for the supply of 10 tons of galvanised steel wire, and 40 tons of galvanised iron wire.

Roumania.—May 15th. The General Direction of the Roumanian Posts and Telegraphs in Bucharest is inviting tenders until the 15th inst. for the supply of 21¾ tons of bronze and copper wire and 600 copper ferrules.

South Africa.—May 15th. The Consul-General of the South African Republic in Amsterdam (Doelenstraat No. 8) is inviting tenders for the supply of 10,000 porcelain insulators, with supports, for telegraph purposes.

Spain.—May 28th. Tenders are being invited by the municipal authorities of Penaranda de Bracamonte for the concession for the electric lighting of the town during a period of 15 years. Tenders to be sent to El Secretario del Ayuntamiento de Penaranda de Bracamonte, Spain.

Spain.—The municipal authorities of Medina de Rio Seco, an old town in the province of Valladolid are at present inviting tenders for the concession for the electric lighting of the public streets during a period of 20 years. Tenders to be addressed to El Ayuntamiento de Medina de Rio Seco (Valladolid province).

CLOSED.

Cheltenham.—The Council has given the contract for 25 arc lamp standards to Messrs. McDowall, Stevens & Co., whose tender was the lowest of seven received, at £9 15s. each for 25 delivered.

Derby.—The Council has recently given out the following contracts:—

Messrs. Siemens Brothers & Co. (two transformers)	£268
„ British Insulated Wire Company (cables, junction boxes, &c.)	£2,185

Grimsby.—A new dynamo is to be purchased from Messrs. P. R. Jackson & Co. for lighting the Town Hall, for £145 10s. The old dynamo is to be retained.

Hammersmith.—The Vestry has placed a contract with Messrs. S. Z. de Ferranti for three rectifiers at £1,044.

Hull.—The Corporation has given the contract for the supply of Kilnhurst and Thryberg hards coal for the electric lighting station, at 11s. 4d. per ton, to Messrs. A. Bannister & Co., of Hull.

London.—The tenders sent in to the London County Council for the supply of mechanical stokers for the Crossness pumping station, were as follows:—

W. B. Haigh & Co., Limited	£1,596
Simplex Stoker and Engineering Company	1,605
J. Proctor	1,625
„ (another offer)	1,439
J. Hodgkinson	1,800
T. & T. Vicars	2,315

Oxford.—As will be seen from our "Electric Lighting Notes," the Oxford Electric Light Company has accepted the tender of the Electric Construction Company for dynamo, and that of Messrs. J. & H. McLaren for engine, for the purpose of extensions here.

NOTES.

The Institution of Junior Engineers.—The following is the synopsis of the paper to be read and discussed to-night at 8 p.m., at the Westminster Palace Hotel, Victoria Street:—"Belgian Electrical Engineering Practice," by Mr. A. Anstruther-Thomson and Mr. G. C. Allingham, Studs.I.E.E., Members. The following is a synopsis:—"Introduction. Short historical sketch of the development of Electrical Engineering in England and abroad. Comparison of Belgian with English practice. Alternating and Continuous Current Systems. The Van Rysselberghe System. Boilers—Lancashire, water-tube, &c. Engines—Slow speed, high speed. Steam Turbines. Dynamos—high speed, flywheel. Accumulators. Electric Traction. Electric Motors in workshops, &c. General conclusions." The Council invite offers of papers for reading during the ensuing Session. A premium is awarded by the Institution for the most meritorious Paper presented by the members. On Saturday morning, May 30th, at 10.30 a.m., a visit will be paid to the works of the Fowler-Waring Cables Company, N. Woolwich.

Autocars.—The horseless carriage has been having quite a good time during the past week. The Imperial Institute and the Crystal Palace exhibitions have been making great efforts to interest the British public in the new forms of street locomotion. On Saturday the Lord Mayor opened the exhibition at the Crystal Palace in the presence of a distinguished company, and on the preceding night at the Imperial Institute was held the inaugural dinner of the Motor Car Club, the afternoon being devoted to a private view and display of the motor carriages.

Electrical Quackery in India.—The electro-medical quack has for some time been very busily engaged in various parts of India gulling the public, who previously had no opportunity of becoming acquainted with his practices. Some of his patients are now discovering that they have been badly bitten, and one of them, in a very plaintive wail in the *Times of India*, warns the public against having anything to do with the "bushy-headed gentleman."

For the Protection of the Professional Man.—Chicago consulting electrical engineers are trying to form an organisation for the purpose of establishing a uniform schedule of fees, and for the mutual enforcement of a stringent code of professional ethics. The movement is well supported, and the outcome is expected to be an association of strictly professional men, who will not compete on a commercial and financial basis.

Society of Arts.—On Monday next, May 11th, at 8 p.m., the third Cantor lecture on "Applied Electro-Chemistry," by Mr. James Swinburne, will be delivered. He will deal with aluminium, sodium, and fused electrolysis. On Wednesday, 13th inst., at 8 p.m., a paper on "Tunnelling by Compressed Air," will be read by E. W. Moir, M.Inst.C.E. John Wolfe Barry, C.B., F.R.S., M.Inst.C.E., will preside.

Electric Tramways for Bolton.—The Council has decided to equip the Daubhill section on the overhead electric system at a cost of £10,050.

The County Council and the Tramway Scheme.—When the report of the Highways Committee was reached, on Tuesday, Mr. T. B. Westacott rose and asked the permission of the Council, in order that the members should have ample opportunity for reflection, that the report should be postponed for a fortnight. The Council accordingly deferred the consideration of the report to the meeting of May 19th. The Highways Committee, in the course of their report, say :—

We have considered a suggestion made by the County of London Tramways Syndicate that arrangements should be entered into between the Council and the syndicate for the immediate transfer to the Council of all the tramways in the County of London.

After setting forth the proposals of the syndicate, which have already appeared in the ELECTRICAL REVIEW, the Committee continues :—

It is quite competent for the syndicate, with the consent of the Board of Trade, to acquire by purchase, under agreement with the owning companies, the various tramway undertakings in London; and it appears to us that until this shall have been done, the syndicate cannot be in a position to make any definite proposals to the Council. Should this transfer to the syndicate of any or all of the undertakings be completed, the syndicate would take the place of the company or companies whose undertaking or undertakings had been purchased; and it would be for the Council then to decide whether it would accept any proposal which might be made by the syndicate, or whether it would defer having anything to do with the purchase of any undertaking before the time should arrive for the exercise of the powers of compulsory purchase under Section 43 of the Tramways Act of 1870. So far as we have been able to learn, however, the syndicate, although it has approached some of the companies, has not come to an understanding with any of them, and we think it may be assumed that the proposals are not in any way based upon successful negotiations with the parties principally concerned in the matter. Passing this by for the moment, we think it necessary to call special attention to the proposal that the syndicate should act as an intermediary between the Council and the companies for the acquisition of the lines. This, in our opinion, is not a proposition which should be accepted. The Council is in a position, if it should so desire, to itself negotiate directly with the companies, and it does not appear to us that any advantage could be obtained by the negotiations being conducted by a third party. The proposal as to the terms on which the various lines should be acquired appears, at first sight, to be favourable to the Council; but it is to be remembered that it is a proposal only, in which the companies interested have not joined. The proposal that the lines when purchased shall be leased to the company for a term of 28 years is, we feel strongly, one that should not meet with acceptance. Practically, the whole of the tramway systems within the county will, by the year 1910, have come under the operation of the purchase clause of the Tramways Act, 1870, and we consider that it would be very undesirable to grant a lease extending beyond that year of any tramway which it may acquire. The syndicate states, however, that it would be unable, on account of the expenditure to be incurred, to accept a lease for any shorter period than 28 years. The syndicate states, moreover, that it would not be prepared to accept any restrictions in the lease as to the manner of working the lines, or as regards the relations of the company with its employés; and these are matters over which, we think, it essential that the Council should have some control. As regards the statement that the company would be prepared to pay a rent equal to the net earnings of the lines during the year preceding the grant of a lease, we are in some doubt as to how this could be done. The proposed reconstruction of the lines to adapt them for electric traction would of necessity take some considerable time, and while in progress the interference with the traffic would in all probability cause a diminution of the receipts from the lines. We may, moreover, point out that it has not yet been demonstrated that the principle proposed to be adopted, namely, electric traction on the underground conduit system, is capable of being worked successfully; and it would be a very serious matter to the Council, as owner of the tramways, if the system were found to be a failure. There is another point in connection with the system proposed, namely, that it would involve the placing in the streets of rails with a slot varying from $\frac{8}{16}$ths to $\frac{9}{16}$ths of an inch wide, which might cause accidents to the ordinary vehicles using the roads. It appears so doubtful whether the system will prove successful, that we venture to think that the anticipation that by its adoption the leasing company would be in a position to pay a rent equal to the present net earnings of the lines, is somewhat sanguine. It will be seen from the above that we are not prepared to advise that the proposals of the syndicate should be accepted by the Council; and we recommend that the County of London Tramways Syndicate be informed that the Council, having given full consideration to the proposals contained in the several letters of the syndicate, is not prepared to enter into any arrangements with the syndicate with reference to the tramways in the County of London.

Louis Quinze.—A well-known and respected member of the electrical industry recently received an order by post, asking his firm to supply some "Louis Cannes" fittings like those purchased from his firm by Lady Vere de Vere. The letter was handed to a customer of good position, who happened to be standing by, to read. Struck by the curious spelling, he ejaculated, "What a fool! Why didn't he put Louis the Sixteenth, if he didn't know how to spell the French word?"

The Royal Society Conversazione.—There was nothing of striking novelty in the electrical line at the Royal Society *Conversazione* on last Wednesday evening. The Röntgen photography was thoroughly well represented by Mr. Swinton and Mr. Jackson, and the applications of the new process to surgery were illustrated by a fine and somewhat ghastly array of photographs exhibited by Mr. Sydney Rowland. But Röntgen photography cannot now be said to be novel. Prof. Ewing's permeability bridge is an ingenious instrument intended for workshop use, as a companion to his hysteresis tester. It appears to be very easily manipulated, and ought to be useful to dynamo makers. Resistance boxes, with coils of bare wire wound on mica, and immersed in oil, were exhibited by Mr. Griffiths and Mr. Burstall; they appear to secure uniform temperature and ready access to the wire, but they look bulky compared with the old resistance box. Mr. Griffiths's resistance box has an ingenious arrangement for testing the comparative errors of the coils. Prof. Clowes showed a simple apparatus for testing for explosive gases in electric culverts. A specimen of the gas is pumped from the culvert by a flexible tube fitted with a hand pump and discharged over a hydrogen flame. The height of the halo produced around the hydrogen flame shows the percentage of explosive gas present. The instrument requires no special skill in its manipulation, and as long as explosive gases are allowed to enter electric culverts and other unsuitable places will be able to justify its existence.

Delay Due to the Local Government Board.—We have more than once spoken of the dilatory fashion in which the Local Government Board does its work. At Cheltenham they are suffering from the extraordinary methods pursued by this Government department, for Alderman Norman, in moving the adoption of the minutes, stated that the Council would be glad to learn that the number of lamps now wired was 6,600, while 600 or 700 were still waiting to be connected with the mains. When they would be in a position to pick up all their customers it was impossible for him to say. No reply had yet been received from the Local Government Board, and the loan applied for last August was still in suspense. This long delay put the Committee to very great inconvenience; the summer months would be slipping away, and work which ought to be done in the long days would again be left over till the short days of autumn. We must really protest against this inaction. If Cheltenham has made out its case, there is not the slightest reason so far as we can see why permission to raise the loan should not have been granted months ago. However, it will probably be our duty to refer again to Local Government methods.

The Cable Ship "Okinawa Maru."—The Japanese Government cable steamer, the gear of which was illustrated in our issue of April 17th, left the Thames on Monday evening for Japan, with about 240 knots of cable in her tanks. She is temporarily in command of Captain Lacey, late of the Western and Brazilian Telegraph Company's service, who will be best remembered in connection with the old *Norseman* cable ship which the company disposed of, and which, we hear, is now lying in the Eastern Dock, Amsterdam, for sale, during the illness of her commander Captain Allen, who has been for a long period associated with the Japanese Government. We are informed that the officers and crew are all natives of Japan, so that Captain Lacey enjoys the distinction of being the only Englishman on board. As will be seen by our further illustrations this week, the vessel presents an exceedingly graceful appearance afloat.

The Institution of Electrical Engineers.—By permission of the General Electric Company, a party of students of the Institution will visit the Robertson Incandescent Lamp Factory at Brook Green, Hammersmith, on Friday, May 15th, at 5 p.m.

At a students' meeting, to be held in the Library of the Institution, 28, Victoria Street, to-night, at 8 p.m., the following paper will be read :—"Single-Phase Alternate Current Transformers in Practice," by A. F. Berry, student.

On Thursday, May 14th, 1896, a paper on "The Influence of the Shape of the Applied Potential Difference Wave on the Iron Losses in Transformers," will be read by Stanley Beeton, C. Perry Taylor, students, and J. M. Barr.

An Opinion re Celluloid.—Writing to *Nature*, Prof. George Forbes gives expression to his opinion of buried celluloid:—"I feared it might deteriorate. I have made an experiment of 4½ years' duration, which may be of use in connection with the subject. On August 15th, 1891, I took four photographic quarter-plate celluloid plates, with the gelatine removed, and treated them as follows: No. 1 was nailed to an outhouse, and became rotten in a year; No. 2 was 1 foot deep in garden soil; No. 3, 1 foot deep in gravel; No. 4, 1 foot deep in a rubbish heap. The last three were dug up on April 6th, 1896. Nos. 2 and 4 were in as perfect a condition as ever. No. 3 has some sand rubbed in, but is perfectly sound. The experiment was made at Pitlochry, N.B. The specimens can be seen at my office."

Glasgow and West of Scotland Technical College.—The following students have completed their three years' course at the Glasgow and West of Scotland Technical College, and passed all the examinations for the electrical engineering diplomas satisfactorily, viz.:—Messrs. Alex. H. Weddell (Uddingston), Thomas Ferguson and John Warrack (both Old Aberdeen), Wm. F. Murdoch (Ayr), and Robert Kilpatrick (London). Of these, Mr. Alex. H. Weddell has been nominated for the "Sir John Pender" gold medal, which is awarded annually to the best student of electrical engineering, who also obtains the College diploma.

Obituary.—It is with the most sincere regret that we announce the painfully sudden death of Mr. J. A. Kingdon, who passed away in his sleep on Wednesday morning at the early age of 37 years. Only the other day Mr. Kingdon, who was an occasional contributor to the ELECTRICAL REVIEW, and whose book on "Applied Magnetism" has been so favourably reviewed, was in this office in excellent spirits, and for one who was always somewhat delicate, in apparently good health. To his bereaved relatives and friends we offer our heartfelt sympathy.

Compensation for Injuries.—At the St. Helen's County Court last week, before Judge Shand and a jury, Mrs. Shadwick claimed £50 compensation from the British Insulated Wire Company, Limited, for injuries received through falling into a hole which had been negligently left unprotected after defendants' employés had been laying or repairing cables in Ormskirk Street on February 10th. The case was settled without hearing, the defendants agreeing to pay £40 in settlement of claim and costs.

A Curious Misnomer.—It is somewhat curious that vessels, which are invariably spoken of in the feminine gender, should occasionally be named after prominent personages of the opposite sex. An addition to the list of such vessels has been made this week in the christening of a new steamer at Sunderland, which will be known as the "*Lord Kelvin*."

Appointment Vacant.—The Shoreditch Vestry want a resident electrical engineer to take charge, under the superintendence and direction of the consulting engineers, of the laying of mains, the erection of electrical and steam machinery for a central station for a minimum period of four months, at a salary of £4 per week.

The Northern Society of Electrical Engineers.—On Monday next, 11th inst., before this Society, a lecture on "The Use and Economies of Rectifiers for Arc Lighting," will be given by Mr. John Hesketh, Member of the Council.

Marriage.—It is our pleasure to congratulate Mr. A. H. Preece (son of Mr. W. H. Preece, C.B., F.R.S., &c.) upon his marriage to Miss Annie Fairclough Butterworth, which took place on 28th ult., at St. George's, Campden Hill, N.W.

Appointment.—Mr. E. W. Dickinson, late of the Bolton Corporation Electricity Works, has been appointed engineer to the Trinidad Electric Light and Power Company, Limited, Port of Spain, Trinidad.

The Royal Society.—Before this Society, yesterday afternoon, a paper by Prof. Gotch, F.R.S., and G. J. Burch, on "The Electromotive Properties of *Malapterurus Electricus*," was read.

Paper.—Before the Royal Scottish Society of Arts, at Edinburgh, on 28th ult., Mr. G. A. Edwards read a paper on "Improvements in the Application of Telephones to Electric Bell Systems."

NEW COMPANIES REGISTERED.

Henry Smith & Co. (Kieff), Limited (47,714).—This company was registered on April 29th with a capital of £50,000 in £10 shares, to acquire, take over, and carry on the business of agricultural implement manufacturers, and importers, telegraph, electrical and general engineers, railway contractors, carried on as "Henry Smith & Co.," at Kieff, Russia, and to adopt an agreement with H. P. Smith, S. Wachtel, and E. Agar. The subscribers (with one share each) are:—E. Agar, 10, Cottesmore Gardens, Kensington, captain; H. P. Smith, First Avenue Hotel, Holborn, engineer; T. B. Tracey, 25, Campden House Road, W., retired; Mrs. M. Agar, 10, Cottesmore Gardens, Kensington; J. Philip, 1, Osborne Place, Dundee, broker; Mrs. J. Philip, 1, Osborne Place, Dundee; S. Wachtel, Kieff, Russia, engineer; Mrs. H. P. Smith, Kieff, Russia. The number of directors is not to be less than two nor more than five; qualification, £500; remuneration, £500 each per annum, and a share in the profits. Registered by H. C. Morris, 2, Walbrook, E.C.

Knoeferl-Bonn Dental and Electrical Manufacturing Company, Limited (47,757).—This company was registered on May 1st with a capital of £10,000, in £1 shares, to acquire and carry on the business of dental appliance manufacturer and mechanical engineer, carried on by F. Knoeferl at 100, Bolsover Street, W., and the business of electrical engineer carried on by J. Bonn, as "J. Bonn and Co.," at 1, Holborn Place, W.C., and to enter into an agreement with the said F. Knoeferl. The subscribers (with one share each) are: G. Gibbs, 68, Prince of Wales Road, Kentish Town, clerk; S. B. Saunders, 7, Pattenden Road, Catford, secretary; J. H. Gartrell, Penzance, dental surgeon; J. Bonn, 1, Holborn Place, W.C., electrical engineer; F. Knoeferl, 100, Bolsover Road, W., engineer; J. H. Greenwood, 485, Caledonian Road, N., secretary; E. A. Robinson, 9, Broad Street Avenue, E.C., merchant. The number of directors is not to be less than three, nor more than six. The subscribers are to appoint the first; qualification, £100; remuneration, £50 each per annum, and £75 for the chairman. Registered office, 9, Broad Street Avenue, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

I.E.S. Accumulator Company, Limited (44,731).—The statutory return of this company, made up to December 29th, 1895, was filed on April 11th, 1896. The capital is £100,000, in £1 shares; 50,000 of these have been taken up, and all have been issued as fully paid. An agreement made March 25th, 1896, between Arthur W. Stormont, merchant, of Metropolitan Chambers, Old Broad Street, E.C., of the one part, Edward Mann, electrical engineer, of Palace Chambers, Westminster, S.W., of the second part, and the company of the third part, provides for the adoption and ratification of an agreement dated July 25th, 1895, and the issue and allotment of 50,000 fully paid shares, 1 to 50,000, to A. W. Stormont. This agreement, dated July 20th, 1895, was made between A. W. Stormont of the one part, and E. Mann (for the company) of the second part, and provided for the assignment by A. W. Stormont of certain patents to the company, and of the right to sell other patents in consideration for 50,000 fully paid shares, and the sum of £3,000, paid as to £2,000 within 14 days of execution, and £1,000 within three months. These patents were described in schedules to the older agreement, but no details appear in the one which has been filed. The payment of the £3,000 was only to be made when £7,000 working capital had been obtained. The registered office was on April 17th removed to 3, Delahay Street, Westminster, S.W.

Chloride Electrical Syndicate, Limited (35,389).—This company's annual return was filed on February 6th. The capital of £262,500 is divided into 110,000 "A," 140,000 "B," and 12,500 "C" shares of £1 each; 45,000 "A," 100,000 "B," and 12,500 "C" shares have been taken up and issued as fully paid. In addition, 65,000 "A" shares have been subscribed for, and the full amount has been called and paid.

Douglas Southern Electric Tramways, Limited (45,701).—This company's statutory return was filed on March 20th. The capital is £50,000 in £1 shares (of which 30.000 are preference); 12,166 preference and 5,904 ordinary have been taken up, and £1 per share has been called. £17,846 10s. has been paid, and £233 10s. is in arrears.

Direct Spanish Telegraph Company, Limited (6,732).—This company's annual return was filed on April 17th. The capital is £95,000 in £5 shares (of which 6,000 are preference); 12,931 ordinary and all the preference have been taken up, the full amount called, and £94,665 paid.

Anglo-American Telegraph Company, Limited (2,891).—The annual return of this company was filed on March 31st. The capital is seven millions in stock, the whole of which is fully paid up.

Crystal Electric Lamp Company, Limited (45,280).—This company's annual return was filed on March 6th. The capital of £15,000 is divided into 1,000 ordinary, 1,600 preference "A" and 400 preference "B" shares, all of £5; 1,000 ordinary, 1,001 preference "A," and 400 preference "B" shares have been taken up, and the ordinary and preference "B" have been considered as paid. £5 per share has been called on the preference "A," £5,000 has been paid, and £5 is outstanding.

Anglo-Portugese Telephone Company, Limited (24,545).—This company's annual return was filed on April 13th. The capital is £75,000 in £1 shares, of which 50,000 have been taken up, and all considered as paid.

CITY NOTES.

St. Pancras Accounts.

Although we criticised last year somewhat severely the electricity accounts of the St. Pancras Vestry, we had nothing but commendation to offer on the method of presenting them. The 1895 figures, which are now before us, are, as usual, admirably arranged, and one obtains their essential features in merely glancing through the accounts. The chief clerk, Mr. Albert E. Pycraft, prefaces that statement of the accounts with some remarks on the principal incidents in the year's work, and before we say anything, we will first let him speak. He says:—

"Of the total amount of loans received, viz., £99,700, the sum of £5,616 1s. 8d. has been repaid. A further loan of £10,000 has been applied for, but is not yet received. The total capital expenditure on account of the Regent's Park station amounts to £113,889 2s. 1d, being an increase on last year's account of £4,522 18s. 4d., which is mainly for extensions of mains, services to consumers' premises, meters and switches, and an application for a loan for this amount is required to adjust the account. In accordance with the resolution of the Vestry of April 17th, 1895, the item £554 4s. 7d. for preliminary expenses appearing in last year's accounts has been written off and charged to the net revenue account. The total revenue for the year amounts to £18,921 17s. 5d., which is a net increase over last year of £1,990 0s. 10d., but inasmuch as the charge for public lighting for the year shows a reduction of £857 7s. 4d., the actual increase from private consumers amounts to £2,847 8s. 2d., or nearly 23 per cent. increase. The total generation expenses amount to £6,737 14s. 5d., an increase over last year of £561 4s. 6d, the larger portion of which is for coal. The distribution expenses show an increase of £1,623 13s. 11d, the large increase under this head being chiefly attributable to the necessity of replacing the whole of the insulators and bearers in the manholes, as a consequence of the explosions in culverts that occurred early in the year. Nearly £600 has been paid to contractors for this work, besides a sum of £300 for extra staff employed in cleaning the incrustation off the old insulators, and other work during the time the new insulators were being put in—a precaution which was absolutely essential, owing to the nature of the incrustation and the liability of further explosions should any accumulation of gas be present in the manholes. After providing for the whole of the foregoing expenses, a profit of £6,575 15s. 4d. on the year's trading has been made (equivalent to nearly 6 per cent. on the capital expenditure) to meet the repayments and interest on loans, &c., which absorb £5,640 10s. 9d., leaving a net profit on the year's working of £935 4s. 7d. This sum added to the balance on last year's accounts of £1,768 6s. 7d., less the sum of £554 4s. 7d. written off for preliminary expenses, leaves a net balance to be carried forward of £2,149 6s. 7d. The following table shows the yearly progress since the commencement of the electricity undertaking:—

	No. of consumers.	Current sold to private consumers.		Number of lamps &c., applied for.		
		3d. per unit.	6d. per unit.	Incandescent. 16 C.P.	Arc.	Motors.
		£ s. d.	£ s. d.			
Dec., 1892 ..	172	....	8,167 7 8	9,990	82	11
„ 1893 ..	238	384 11 6	9,161 6 0	12,851	110	19
„ 1894 ..	349	1,236 13 9	10,819 15 9	15,532	129	22
„ 1895 ..	447	2,142 9 6	12,682 6 0	19,195	139	37

After the lengthy remarks we made last year on the peculiar views held by the St. Pancras Vestry on the subject of depreciation, it is scarcely necessary to say more than that the Vestry still pursue the course of regarding the repayment of loan as equivalent to setting aside sums of money for depreciation.

The total indebtedness of the Vestry for electric lighting stands at the present moment as follows:—

£79,865 borrowed at 3½ per cent.
£14,219 „ „ 3¼ per cent.
£16,449 borrowed from bankers at probably 3½ per cent.

£110,533

which is, in round numbers, £12,000 less than it stood last year, the decrease being due to the reduction of loan from bankers from £27,113 to £16,449. A further loan of £10,000 has been applied for.

An examination of the cost of production will show that the repairs and maintenance are somewhat high, due to considerable alterations in the mains which are referred to by Mr. Pycraft.

We do not often refer to the statement of electricity generated, sold, &c., but in this case they are somewhat curious. 171,297 units were supplied for public lamps, and 678,690 for private lighting, but the total quantity unaccounted for is slightly over one-sixth of that accounted for, or nearly 15 per cent. of the quantity generated. It is not easy to compare this with many works, for some electricity works' managers are rather modest in speaking of their achievements in this direction, but the loss is certainly greater than in most of the accounts which give this return.

The following table gives the cost per unit:—

	1893.	1894.	1895.
Total capital expended... ...	—	£109,931	£113,889
Number of units sold	—	719,484	849,987
Number of lamps connected ...	—	36,328	—
Revenue from sale of current...	—	£16,482	£18,393
Net revenue	—	£7,233	£6,576
Average price obtained per unit	—	5·5d.	5·24d.

Cost of production.	£ s. d.	Per unit.
Coal	3,358 0 0	·95d.
Oil, waste, water and engine room stores	543 0 0	·15d.
Salaries and wages at generating station	2,567 0 0	·72d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	3,655 0 0	Works' cost 2·85d. 1·03d.
Rates and taxes	406 0 0	·11d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	1,817 0 0	·51d.
Depreciation of buildings and plant account	—	—
Renewal fund account	—	—
Total	£12,346 0 0	3·47d.

Revenue.	£ s. d.	Average price obtained per unit.
By sale of current	183,393 0 0	5·24d.
Meter rents	463 0 0	—
Other items	65 0 0	—
Total	£183,921 0 0	5·24d.

Total cost per unit (exclusive of depreciation and renewal accounts), 3·47d.; works' cost, 2·85d.

Electric Lighting Shares.

In the May number of the *Investors' Review*, the subject of Electric Lighting Shares is most ably handled. The fact that the criticism is confined to London companies has a somewhat narrowing influence on the writer's conclusions; but, altogether, the article is one of the soundest that has yet appeared in the financial Press. There is one statement, however, which we should like to correct or, rather, amplify, that is, "that electric lighting is a success so far as the luxurious classes are concerned." Now, it is one of the strongest claims of electric lighting that its use in comparatively poor neighbourhoods has been relatively more successful than in many rich districts. Some time ago we gave the Brighton Corporation's engineers opinion to the effect that the artisan shopping districts of Brighton were more profitable to the electricity works than the fashionable neighbourhoods of King's Road and North Street; and, further, the price paid for electricity in the poorer districts of Brighton, owing to the method of charging, was actually less than gas. The increase in the consumption of electrical energy from eight to nearly 20 millions in three years, says the writer, is a great stride in conservative England, and proves definitely that the light has great merits in use, despite its apparent costliness, both as regards installation and annual charge. After noting the spread of electricity works into comparatively poor neighbourhoods, the article records the dividends of the London companies. The remarks on depreciation are to be commended, and the following table, which

shows the influence of depreciation on the revenue, is worth reproducing:—

Companies.	Sale of current.	Rental of meters, &c.	Working expenses.	Depreciation allowed for out of revenue.	Sums written off preliminary expenses, or added to reserve.
	£	£	£	£	£
Charing Cross and Strand	27,859	347	12,983	3,000	1,000
Chelsea	16,006	642	8,275	nil.	...
City of London ...	104,102	2,623	49,328	nil.	1,338
House-to-House ...	14,389	881	8,554	2,000	1,228
Kensington and Knightsbridge ...	28,090	920	12,782	5,571	...
Metropolitan ...	98,793	7,446	67,293	12,000	1,000
Notting Hill ...	5,881	561	3,215	891	...
St. James's and Pall Mall	41,583	1,076	19,684	6,061	...
Westminster ...	65,445	3,050	29,740	10,809	2,500

The management of the City Company is, however, most severely criticised, and we reproduce the comments as they stand.

"In the above it will be noted that the amounts set aside for depreciation and other charges form usually a good proportion of the profits left after deduction of ordinary working expenses. In two cases, however, we show that practically no such deductions have been made from revenue at all. This seems remarkable, after what we have said about the Board of Trade and its watch over the accounts of the companies, and our examination into this matter has laid bare one of the most magnificent feats of financial legerdemain we have been favoured to witness. We refer to the accounts of the City of London Electric Light Company, a company specially favoured by Parliament and the Corporation of London. Its Act removes it, to a certain extent, from the supervision of the Board of Trade, with the result that expenditure has been placed to capital account, which would never have been passed by a Board of Trade auditor if suggested by another company. Even its allowances for depreciation seem to be only compulsory so far as the machinery and plant for generation are concerned. Through the over-shadowing wing of the Corporation, it has been allowed to retain a monopoly of electric lighting in the City, and by virtue of this monopoly it continues to levy its maximum charge of 8d. per Board of Trade unit for a service which is not particularly good. Yet, with all these advantages, it has taken the most elaborate pains to prevent all charges for depreciation and preliminary expenses from falling upon the revenue account. And this has been effected by what is undoubtedly an abuse of the system of dealing with premiums received upon new capital. Instead of obtaining its capital upon the best terms, this strong company, with the best area for lighting in the whole of London, has been issuing preference shares bearing 6 per cent. interest, and debenture stock bearing 5 per cent. interest. A liberal allowance for contingencies would have been made if the preference shares had been 5 per cents., and the earlier issues of debenture stock had borne 4 per cent. and the later ones 3½ per cent. interest; but, by retaining these high rates of interest, the company has netted premiums upon its issues of £200,000 preference and £400,000 debenture stock to the extent of no less than £144,000. Of this huge sum, it has already used nearly £73,000 in wiping off preliminary expenses, meeting each year the statutory depreciation, repairs and maintenance of machinery, buildings, plant, lamp-posts, tools, &c., and finally the 5 per cent. of the profits which it is bound to set aside to reserve. A balance of £64,000 remains in its hands, and possibly it is intended to employ it in the same way in succeeding years. The conduct of the board in this matter is all the more reprehensible, as in 16 years the redemption of the £400,000 of debenture stock would be possible, but it could only be paid off at 125 per cent., so that £100,000 would be required to rid the company of the heavy charge thus involved. To show the effect of these methods upon the finances of the company, we will take its return for last year. In the first place, capital was credited with a lump sum of £5,876 for 'Rents, rates and taxes, salaries, directors' fees, remuneration of former chief engineer, professional charges, &c.,' which expenditure every other London electric company would have had to set down to revenue, while £3,808 for renewals and repairs of buildings and plant, and £3,222 for repairs, maintenance and renewals of mains, lamp-posts, and transformers, were met by drawing upon the funds obtained from premiums. The company's revenue account last year benefited to the extent of £12,900 from this policy. If these charges had been placed upon revenue, the balance left for the ordinary shareholders, after meeting debenture and preference interest, would only have been £10,800, which would have allowed of a dividend of no more than 2½ per cent., and the carrying forward of £800. As it was, by its arithmetical conjuring, the board was able to declare a dividend of 5 per cent. and carry £3,776 forward. If the statutory depreciation is taken into account, the record would have been still worse, and no more than 1 per cent. could have been paid. The Chelsea Company seems to have been so dazzled by the brilliant finance thus exhibited, that it has followed the same policy to a small extent, but of course it met all renewal and maintenance charges out of revenue.

"The incident, however, shows the necessity of laying down some rule as to the treatment of premiums received upon new issues. The gas and railway companies are bound to treat such receipts as capital, and the same law ought to apply to electric light undertakings. By its present vicious methods, the City of London Company is laying heavy charges upon its future revenue, which in the end will prove more detrimental to the consumer than anyone else, for we believe that the company is bound to reduce its price when a certain rate of dividend is paid upon its shares. At the same time, its methods tend to hide up the extravagant manner in which it is managed. If the sums we have mentioned are added to its cost of production of energy, it will be found that instead of being about 3·65d. per unit, the cost is nearer 5d. per unit, or nearly ½d. per unit above the average cost of other companies. This does not reflect credit upon the management, as the company has the largest revenue of any company in London, its 'load' is believed to be one of the best, and its area is very compact.

"Apart from this ugly blemish, the companies seem to have done very well. They have in most cases managed to reduce their charges to the public materially below the maximum price permitted by enactment."

After jibing at the founders' shares with which so many companies are "cursed," the writer allows that the companies appear to have a good future before them, and probably the present range of dividends will be improved upon.

The Chelsea Electricity Supply Company, Limited.

The new issue of 12,000 £5 ordinary shares is announced, the list opening on Thursday, and closing on the following day. A premium of £2 per share is charged, which, considering the strong position the company occupies, is probably not excessive. The district in which the Chelsea Company have powers is undoubtedly an improving one, and with the extension of the mains and the erection of a new generating plant, for which the new capital is required, the company should more than maintain its previous prosperity.

The Brazilian Submarine Telegraph Company, Limited.

The report of the directors and the accounts for the half-year ended December 31st, 1895, to be submitted to the 45th ordinary general meeting, May 13th, 1896, states that the revenue for this period amounted to £106,167 13s., and the working expenses to £21,623 7s. 3d. After providing £3,200 for debenture interest and sinking fund, and £1,705 12s. 10d. for income-tax, there remains a balance of £79,638 12s. 11d.; to this is added the sum of £4,410 9s. 3d. brought forward from June 30th last, making a total of £84,049 2s. 2d. First and second interim dividends, amounting to £39,000, have been paid, and £30,000 transferred to the reserve fund, leaving the sum of £15,049 2s. 2d. to be carried to the next account. The receipts for the half-year include the sum of £1,500 dividend to June 30th, 1895, on the company's shares in the African Direct Telegraph Company, Limited. The various sections of the company's lines are in good working order.

The Great Northern Telegraph Company of Copenhagen.

The general meeting of this company was held at Copenhagen on April 25th, 1896. Mr. F. Zahle presided.

The managing director, Commodore E. Suenson, D.R.N., in rendering an account of the working of the company during the year 1894, made the following remarks:—With regard to the state of the cables, the year 1895 has been less favourable than the preceding year. In Europe, nine cables have been interrupted 16 times, and in the Far East there have been 14 interruptions of six of the cables, without reckoning renewals and stregthening of weak places. The cable steamer *H. C. Orsted* has been employed on active service for 157 days, and the *Store Nordiske* for 229 days, 113 of which, however, were for the account of other Administrations, including the Japanese Government. Amongst the work executed for the latter may be mentioned a second connection between the Japanese islands of Tsushima and Iki, the cable being taken from our stock in China, and the value credited to the reserve fund. In Siberia, the Wladiwostock line has not given all the satisfaction that could be desired, neither with regard to the condition of the line itself nor to the transmission of the traffic. The Russian Government has, however, sanctioned the outlay of considerable amounts for the improvement of this line, and the Imperial Telegraph Administration is actively engaged on the restoration of the line, and the reorganisation of the service. The military and political events in the Far East, which during the latter half of 1894 created an extraordinary traffic on our eastern cables, may be said to have lasted during nearly the whole of 1895, although the war between China and Japan was practically ended in March, and peace finally concluded at Shimonoseki on April 17th last year. After this, Japan had, however, to continue military operations on the Island of Formosa, the pacification and annexation of which was, in fact, accomplished only towards the end of the year; it also took some time before the Japanese troops evacuated the Chinese Continent and Korea. Add to this the Missionary troubles and the insurrectionary movements in China, as well as the numerous political and financial negotiations between Europe and the Far East, and it will be understood why the telegraphic traffic has been so considerable during the past year. Nearly the whole of this traffic has passed over the cables, as the competing Chinese lines have practically been closed owing to the war and to the Chinese Administration's refusal to transmit code telegrams over their lines. It was

only in the month of December last that the competition of the Chinese line—the Helampo route—with the cables was resumed, after having ceased since the beginning of the war, and it was taken up with the same animosity as in 1893-94, thus forcing us to reduce our rates in China to the same level as those of the Chinese. This resumption of the competition came to us as a surprise, as in order to avoid it we had opened friendly negotiations with the Chinese Administration in the month of March under the anspices of H.E. Count Cassini, the Russian and Danish Minister at Pekin. In these negotiations, we went to the utmost possible limit of concessions, the terms offered by the company being entirely satisfactory in the opinion of the Minister, who must be considered an impartial mediator between the two parties. The terms were, at all events, very favourable to the Chinese, who, however, wanted time for consideration, and in the meanwhile, as mentioned above, resumed the competition without giving any definite answer to our proposals. In spite of this, and thanks to the extraordinary events already mentioned, and to the satisfactory traffic on the European system, the year 1895 has, nevertheless, been an exceptional one from a financial point of view. The net traffic receipts have reached the amount of £370,700, that is to say, £55,935 more than in 1894, although the value of the dollar has not sensibly increased during the year. "Sundries" also appears at an unusual figure, which is due to the extensive employment of the cable steamer *Store Nordiske* by the other parties already referred to. In these circumstances, and in order to meet the wishes expressed by a number of shareholders, the board of directors have decided to propose to make the final dividend 2s. 10d. per £10 share more than the preceding years, which will make a total dividend of £1, or 10 per cent. It is not without hesitation that this proposal is made. It might have been more prudent to keep the whole of the exceptional surplus receipts in reserve, in order to place the company in a better position to face the demands and claims, which are sure to be made in the near future, although provisionally put off by extraordinary and unforeseen events. Whether our differences with China be adjusted or continued, they are sure to necessitate great sacrifices on our part. Further, at the International Telegraph Conference, which will meet at Buda Pesth next June, we must be prepared to meet demands for great tariff reductions. Lastly, the efforts for completing the submarine telegraph system of the globe by the laying of cables in the Pacific have lately developed to such an extent, that we may be called upon at any moment to take an active and costly part therein. In these circumstances we cannot sufficiently strengthen our resources and our resisting power, and with this in view we have considered it necessary also to increase our amortisation fund by adding an extraordinary amount to the same. The company have suffered a sad loss in 1895 by the death of Colonel Valdemar Hoskiær at the age of 66 years. Colonel Hoskiær took a very active part in the organisation of our technical service in the early days of the company, and supervised the manufacture and laying of several of our cables. He joined the board in 1876, and attended to his duties until his death with never failing interest.

The report and balance-sheet were adopted, and Lieut.-Colonel V. E. Tychsen was elected, and the retiring director, C. F. Tietgen, Esq., was re-elected as members of the board of directors. A. Berner, Esq., and S. Bille, Esq., were re-elected as auditors of the company.

The Western and Brazilian Telegraph Company, Limited.

The report of the directors, to be presented at the thirty-first ordinary general meeting of the company, states that the total earnings amount to £80,315 2s. 10d., as against £82,815 11s. 11d., showing a decrease of £2,500 9s. 1d., compared with the half-year to December 31st, 1894. The working expenses amount to £38,122 9s. 11d., as against £36,403 17s. 3d., an increase of £1,718 12s. 8d. Including the amount brought forward from June 30th, 1895 (£5,803 7s. 5d.), and the dividend received upon the shares held in the "Platino" Company, the balance to the credit of the revenue account is £52,614 2s. 10d., from which has been deducted £11,148 for debenture interest, and £7,952 for the debenture redemption fund, leaving £33,514 2s. 10d., of which £3,000 has been placed to the reserve fund. The directors now recommend the payment of 5s. 3d. per share, free of income-tax, for the half-year on the ordinary shares, making, with the dividend paid in November last, £3 per cent. for the year, the same as paid for 1894, leaving a balance of £4,952 13s. 7d. to be carried forward. In the case of shares which have been divided into "preferred" and "deferred," the 5s. 3d. per share now recommended will be payable, viz., 3s. 9d. to the "preferred" shareholders (making up the full dividend of £5 per cent. on these shares for the year 1895), and 1s. 6d. per share to the "deferred" shareholders. There is no change in the position of affairs between the Government of Brazil and the company as to the purchase of the cables. The directors have to report the sale of the ss. *Viking* to the Amazon Telegraph Company, Limited. Each company called in an independent expert of the first standing, and these gentlemen agreed that the value of the ship, after having passed Lloyd's Special Survey No. III., and being classed A1 at Lloyd's, was £12,300. In order to retain this classification a sum of £1,329 18s. 2d. had to be spent upon the vessel. After adding this to the amount, the *Viking* stood at in the last accounts, viz, £8,500, there remained a balance of profit of £2,470 1s. 10d., which amount the directors have applied in reduction of *Norseman* No. 1; and as since the close of the year the vessel has been sold at a loss, they have written this off against the reserve fund. In the accounts for the current half-year the matter will be finally dealt with. An International Telegraph Conference, at which this company will be represented, will be held at Buda Pesth in June next, to consider the rules, regulations and tariffs of the Telephone Convention. The seventh annual drawing of the "A" and "B" debentures took place at the company's offices on January 13th last, in the presence of Mr. W. W. Venn, jun., notary, when debentures amounting to £15,900 were drawn, and have since been paid off at par. The dividend warrants will be posted on May 15th, 1896. The retiring directors are Lord Richard H. Browne and Mr. John Coppen, who offer themselves for re-election. The auditors, Messrs. Turquand, Youngs, Bishop & Clarke, retire, and are eligible for re-election.

Official Announcements re Companies.

Notice is filed in the *London Gazette* of May 5th to the effect that the following companies have been struck off the register, and are accordingly dissolved:—

British Electric Tramways and General Syndicate.
Brompton Electric Fittings Company.
California Gas, Water, and Electric Light Company Syndicate.
Cheshire Electric and Steam Yacht Company.
"Energy" Gas, Electric Lighting, and Power Company.
Engineers' Gazette, Limited.
Lancashire Electric and Engineering Company.
South Western District and Thames Valley Electricity Supply Co.
Wyndham Electric Light Company.

The following companies will be struck off the register at the expiration of three months, unless cause is shown to the contrary:—

American Insulated Wire Company.
American River Electric Power Supply Company.
Commercial Electricity Supply Company.
Day's Gas Engine Company.
Electric Clock Company.
Electric Semaphore Signal Syndicate.
Elieson Accumulator (British patent) Syndicate.
Industries and *Iron*, Limited.
London Electric Manufacturing Company.
Merionethshire Electric Lighting, Power, and Appliance Company.
New Electro-Metallurgical Syndicate.
Putney Electric Supply Company.
R. C. Cutting Douglas & Co.
Saycee Electrical Syndicate.
Theatre Electrical and Specialities Production Company.
United Electric Sewage and Chemical Syndicate.

China and Japan Telephone Company, Limited.

The thirteenth ordinary general meeting of this company was held on Tuesday last, at the offices, Austinfriars, under the presidency of Mr. Henry Grëwing, who said that the improvement in the position of the company had continued, and gave promise of making still further progress. The revenue account, after charging it with debenture interest, showed a balance to credit of £934, which had been transferred to profit and loss account; including £361 brought forward from 1894, this account shows an amount to credit of £1,295. Of this sum the directors proposed to place £750 to reserve, and to carry forward the balance of £545. The result of the working of the exchanges for the past year at both Shanghai and Hong Kong was satisfactory; the income at both stations had been considerably increased at but small additional expense to revenue, although it had necessarily involved further capital outlay. The sphere of the operations of the company was, they knew, a restricted one, but the recent events in China showed that the Government were inclined to give more liberal treatment to foreign enterprise, and their company would benefit indirectly in a variety of ways, because with the growth of factories and manufactures in China, they would have greater demands for telephone services. Ten years ago the company had 70 subscribers, and they now had over 300. The bond for £5,000 issued in 1891 to secure the debentures held by the Oriental Telephone and Electric Company fell due on December 31st last, and had been extended for a further period of five years with the consent of that company.

The report was adopted.

West India and Panama Telegraph Company, Limited.—The directors have declared a dividend of 6d. per share on the ordinary shares for the half-year ended December 31st.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending May 3rd, 1896, were £878; week ending May 5th, 1895, £864; increase, £14; total receipts for half-year, 1896, £17,027; corresponding period, 1895, £16,983; increase, £44.

The Direct Spanish Telegraph Company. The estimated receipts for the month of April, 1896, £2,422.

The Great Northern Telegraph Company. The traffic receipts in April, 1896, amounted to £23,200; 1st January to 30th April, 1896, £90,000; corresponding months, 1895, £95,600; corresponding months, 1894, £83,000.

The Liverpool Overhead Railway Company. The receipts for the week ending May 3rd, 1896, amounted to £1,145; corresponding week last year, £1,148; decrease, £3.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 1st, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,583.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, April 29th.	Closing Quotation May 6th.	Business done during week ended May 6th, 1896. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 –104	100 —104	100½	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	10½— 11	10½— 11	...	...
1,912,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	49 — 51	50 — 52	51⅛	49½
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	92 — 93	92½ — 93½	93⅜	90½
2,993,560£	Do. do. Defd.	Stock	...	...	...	10 — 10½	9⅜ — 10⅜	10¼	9⅜
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	...	14¼ — 14⅜	14⅛ — 15	15	14½
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 - 117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3 — 3½	3 — 3½	3 7/16	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12 — 13	12 — 13	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½ — 21½	20½ — 21½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	106 —109 %	106 —109 %	...	...
60,710	Direct United States Cable, Ltd.	20	2½% §	2 %	...	9½ — 10	9½ — 10	10	9⅞
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	...	17 — 17½	17 — 17½	17⅛	17¼
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18 — 18½	18 — 18½	18⅛	18¼
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	104 —107	106 —109	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	129 —132 xd	129 —132	132½	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	18 — 18½	18 — 18½	18 7/16	18
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	101 —105	101 —105	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	102 —105	102 —105	102½	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	130 —133	130 —133	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	102½	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	105 —108	105 —108	105	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	112 —115 %	110 —113% xd	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅝% §	4½%	...	10½— 11	10½— 11	10⅝	10½
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	...	16⅝— 17¼	16⅝— 17¼	17¼	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	10 %	23 — 23½	23 — 24	23½	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	53 — 56	53 — 56	55⅝	54
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5¼%	7⅞ — 8⅛	7⅞ — 8⅛	8⅛	7⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16½ — 17½	16½ — 17½	17¼	17½
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6¾ — 7	6¾ — 7	6 15/16	6 13/16
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	108 —111	108 —111	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4¼%	5 %	3/16— 1/4xd	3/16— 1/4	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 —111	108 — 111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	...	5 — 6	5½ — 6½	6¼	5½
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138	133 —138	137½	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	3¾— 4	3¾ — 4	3 13/16	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	97 —102	97 —102	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	...	5½— 6½	6 — 7	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	102 —105	102 —105	...	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	97 — 102	97 —102	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	3 %	9 — 9½	9 — 9½	9¼	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½— 7	6½— 7	6 15/16	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	2½— 3	2½— 3	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	104 —108	104 —108	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	104 —108	104 —108	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	⅞%	⅞%	1⅛— 1⅜	1⅛— 1⅜	1 5/16	1⅛
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11⅛— 11⅜	11⅛— 11⅜	11⅜	11⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	113 —118	110 —115 xd	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	7½— 8	7½— 8	7⅞	7⅞
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7½— 7⅝	7½— 7⅝	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	116 —119	116 —119	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14½ — 15½	14½— 15½	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½ — 17	16½— 17	17	16 9/16
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	134 —138	134 —138	...	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	*nil*	8 — 9	8 — 9	8½	8⅛
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	6 %	12½— 13½xd	12½— 13½	13⅜	13½
50,000	†Liverpool Electric Supply, all paid	5	5 %	5½%	6 %	7⅜— 7⅞	7⅜ — 7⅞	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	4 %	13 — 14	13 — 14	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	119 —122	120 —123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	9 — 9½	9 — 9½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7¼%	10¼— 10⅜	10¼— 10⅜	9⅞	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	9¾ — 10¼	9½ — 10	10	9 13/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, April 29th.	Closing Quotation, May 6th.	Business done during week ended May 6th, 1896. Highest.	Lowest
£ 90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	5 % §	2½%	...	1⅛ — 1⅜	1⅛ — 1⅜	1 5/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1⅜ — 1⅞	1⅜ — 1⅞	...	...
125,000 £	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
630,000 £	City and South London Railway	Stock	1 1/16%	1½%	1 5/16%	40 — 42	41 — 43	42	41⅝
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	...	2¼ — 2⅜	2 — 2⅛	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	... ...	1¼ — 1⅜	1¼ — 1⅜	1⅞	1⅝
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	...	3 — 4	2½ — 3½	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	1⅛ — 1⅜	1⅛ — 1⅜	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2¼ — 2⅜	2¼ — 2⅜	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	5/8 — 7/8	5/8 — 7/8	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	5/8 — 7/8	5/8 — 7/8	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil*	...	¼ — ⅜	¼ — ⅜	...	...
9,600 £	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	...	9½ — 10½	9½ — 10½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	16½ — 17½	16½ — 17½	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	16½ — 17½	16½ — 17½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	107 —112	108 —113		...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	23½ — 24½	23½ — 24½	24	22¾
200,000 £	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	... ...	... ...	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅜%	14 — 14½	14 3/16 — 14 5/16	14 5/16	14 3/16
10,000 †	Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅜ — 16⅞	16⅜ — 16⅞	40½	39½
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	38 — 41	38 — 41		
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000 £	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	8¼ — 8⅜	8¼ — 8⅜	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½% § 1890—5%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾—6¼.

Electric Construction Corporation, 6 % Debentures, 102—105.

House-to-House Company (£5 paid), 3⅛—3⅜.

Do. do. 7 % Preference, of £5, 8⅛—8⅜.

Do. do. 4½% Debentures of £100, 109—111.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 8¼—8¾; 1st Preference Cumulative 6 %, £5 (fully paid), 7¼—7⅞.

Liverpool Electric Supply, £5 (fully paid), 7⅞—8¼.

London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7—7½.

Bank rate of discount 2 per cent. (February 22nd, 1894).

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The session now drawing to its close will probably be remarkable in the history of the Institution of Electrical Engineers for the critical spirit that has been openly manifested by certain of the members. This spirit of unrest and dissatisfaction, although voiced by comparatively few, is well known to permeate a very large section, and this is not directed only against some one department of the work or function of the Institution. Beginning with a forcibly-expressed distrust in the ability or willingness of the Council to select a president to whose election no objection could be raised, the critical spirit so rapidly leavened the whole lump, that a wise decision averted a catastrophe. But the discussion of one weakness naturally led to the recognition of many others, and having succeeded in the first attempt at reform, it may safely be left to the awakened members not to stay their hands till they have made such changes as shall give them what they certainly do not now possess—an Institution fully alive to its duties and its potentialities, and filling its proper position adequately, and with dignity. The present time presents a great opportunity, which, neglected for a few years, will be lost. Electrical science and its application advances rapidly, covering each year some new territory, increasing constantly the number of those engaged or interested in it. It cannot be asserted by anyone that the Institution progresses with the industry. For our part, we doubt if a single member could be found to make such an assertion on its behalf. Year by year its membership grows, and its funds increase; but we look in vain for signs of increased usefulness, of improved standards either in the numbers or the character of the audiences at the meetings, or in the papers read at those meetings. We do not, on this occasion, intend to discuss any question of the government of the Institution—whether past presidents should or should not have votes on the Council; whether the accounts are presented in a proper form, or whether it is or is not more important to discuss questions vital to the life of the Institution, rather than papers that may or may not be of some general interest. These and other matters will doubtless all, in due course, receive the attention of members, so we simply confine ourselves to calling attention to the expiring session, as illustrating very strikingly the failure of the Institution, even to approach, in a very important matter, the high standard that its position and opportunities demand. Without criticising the few papers that have been presented to it, and have been discussed at its numerous meetings, we say, without hesitation, that the net result is utterly unworthy of a large institution connected with, and presumably representing an important and rapidly advancing scientific industry. It may be argued that the functions of this and of similar institutions as publishing bodies, must necessarily be curtailed and modified by the growing importance of channels for disseminating information, especially information that demands prompt publication. There is some little force in this argument, but we think, and the experience of other societies justifies us in doing so, that the time has not arrived—nor do we believe it ever will arrive—for the technical press to supplant the technical institutions in this matter. It is, or should be, the aim of such institutions to consider and discuss questions of great importance. The technical press has to publish many kinds of information, much, in its very nature, ephemeral, and to this material it adds other and more permanent matter, including reports more or less full, of the proceedings of the institutions. We are free to acknowledge that even in its narrowest aims the technical press loses rather than gains by any failure of the technical institutions to properly develop this important field of usefulness.

If it is asked why the Institution of Electrical Engineers is so signally failing in this respect, we think two causes will be found in operation, though so intimately connected are

they, that they may well be regarded as one. The first is, that the Institution makes no attempt to secure good papers, nor to interest the best of its members—or prominent non-members—in its proceedings. The second is, that the actual or potential authors of good papers will not offer them to the Institution, since it is no longer considered an honour to have work laid before the Institution, and because the character alike of the audience and of the proceedings is not such as to act as an inducement. We have ample evidence on these matters. While we find that prominent men receive invitations from the Institution of Civil Engineers and other societies, whether they are or are not members, it appears that it is exceedingly rare to receive such invitations from the Institution of Electrical Engineers. We find that when a paper is to be read, at any other Institution than the Electrical Engineers, special efforts are made to secure good discussions; the men who are specialists in the particular subject being cordially invited. In this and other ways good audiences are obtained, numbering very many experienced men of good position. Such audiences compare very favourably with the gatherings characteristic of the Electrical Engineers' meetings of the last year or two.

Again, another Institution issues yearly an admirable list of subjects on which it desires papers—a list that is evidently the result of careful study, and which always shows a close acquaintance with the drift of progress. If the Electrical Engineers merely issued a selection from this list, it would do good service. But so far as we are aware it does nothing.

The American Institution of Electrical Engineers—a much smaller body, with smaller funds, appears to do much, very much, better work, and more of it. Perhaps the comparative youth of its Council is the explanation.

We earnestly commend to the Council the necessity for making some comprehensive arrangements for the better carrying out the duties of the Institution in this matter of papers and meetings, and we commend the subject to the attention of all those who have the welfare of the Institution at heart.

PRINCIPLES OF THE MAGNETIC FIELD.

Many writers on magnetism treat their subject with great complexity, the result being that the average reader is content to leave their pages unread. The cause of this is probably scientific conservatism, which makes our doctors and professors disinclined to adopt what they regard as new fangled ideas. Some of the leading authorities, for example, disapprove of the term "Reluctance," and others exhibit a reluctance to employ the expression "Magnetomotive force." They regard the ideas involved in these quantities as inaccurate, and the analogy between the electric and magnetic circuits as unscientific.

That this is not the case in America is evident from the articles on the magnetic field now running through the columns of *Electric Power*, New York, from the pen of Dr. Bedell. Prof. Rowland was one of the first to suggest a law for the magnetic circuit resembling Ohm's law, and it is natural, therefore, that our American cousins should wish to take as much credit as possible for this idea. It should not be forgotten, however, that the expressive terms reluctance and magnetomotive force, which we are glad to see adopted by American writers, were introduced by Britishers. The true law of the magnetic circuit, moreover, was first formulated by Drs. J. and E. Hopkinson. Dr. Bedell adopts the Hopkinson treatment and the terms proposed by Bosanquet and Heaviside, but Rowland alone is mentioned in connection with the law of the magnetic circuit.

There still exists some confusion as to the meanings of the quantity represented by H, and usually termed the magnetic force or the magnetising force. Some writers seem to regard this quantity as representing the strength of the magnetic field, supposing there were no iron in the magnetic circuit, and, in fact, confuse the magnetic force, H, with the induction, B. It is true that in the case of an air gap, the induction, B, is numerically equal to the magnetic force, H, when both quantities are measured in their respective C.G.S. units. This results from the fact that the permeability of air is taken as 1, and the dimensions of μ are generally suppressed. If the dimensions of the permeability were expressed according to Prof. Rücker's method, induction and magnetic force would have different dimensions, and must consequently be measured in different units. Dr. Bedell calls attention to the true meaning of the magnetic force H, which is equal to the magnetomotive force per unit length. This method of defining H has already been introduced in this country.*

The investigation of the energy of a magnetic field by Dr. Bedell is of considerable interest. If S = the number of turns of the exciting coil, N = the magnetic flux, and if i, t, and w represent instantaneous values of current, time and energy, then there is an electromotive force due to self-induction $S \frac{d N}{d i}$, which is also equal to $L \frac{d i}{d t}$, where L is the coefficient of self-induction. The change of energy of the magnetic field $= L\, i \frac{d i}{d t} d t$. To find the energy of the field when the current has a particular value, I, it is necessary to integrate the expression $d w = L\, i \frac{d i}{d t}\, d t$ between the limits o and I, and this gives: Energy of magnetic field $= \frac{1}{2} L I^2$. This may also be expressed in terms of B and H as follows:— $S\, i = H\, l \div 4\, \pi$, and $N = A\, B$ where A is the cross-sectional area of the magnetic path. Hence $\frac{d N}{d t} = A \frac{d B}{d t}$ and $d\, w = \frac{1}{4\, \pi} H\, l\, A \frac{d B}{d t} d t$. Hence $W = \frac{A\, l}{4\, \pi} \int H\, d\, B$ = the total energy of the magnetic field. Now, $A\, l$ is the volume of the core of the magnet, and $\int H\, d\, B$ is the area of the hysteresis curve connecting B and H. Hence it appears that the energy stored up in the magnet in consequence of its self-induction is equal to the volume of the core × the area of the hysteresis curve ÷ 4 π, and it is well known that this quantity represents the energy dissipated in heat owing to hysteresis. This, of course, applies to magnets having iron or other cores subject to hysteresis. In the case of air core magnets there is no hysteresis, and the stored energy is returned to the circuit in the form of what has been generally known as the extra current.

At the end of the paper, Dr. Bedell deals with the energy of two circuits, such as the primary and secondary of a transformer.

RECENT EXPERIMENTS WITH THE GLOBULAR DISCHARGE.

(*Continued from page* 495.)

In order to study more conveniently the form of the luminous mass, Righi frequently took photographs of it. When it moves slowly—or, better still, when it remains for a moment at rest—an image can be obtained by working the shutter of the camera by hand; or, at least, an ordinary pneumatic shutter may be used. When, on the contrary, the globular discharge has a considerable velocity of translation, a so-called instantaneous shutter must be used.

The instantaneous shutter employed by Righi consisted of a disc of cardboard strengthened by aluminium ribs, having an exposure aperture cut in it, which passed in front of the lens when the disc was rapidly rotated by a clock spring. The rapidity of the exposure depended on the tension put upon the spring, and was measured by a tuning fork of known frequency drawing a wavy line on a piece of smoked glass attached to the disc. The shutter was not mounted on the camera, but on a separate support, to obviate vibration. To ascertain when the shutters should be released, the following plan was adopted: When, by means of a pendulum electroscope, it could be seen that the condenser had attained the necessary value, the circuit was rapidly closed, and, finally, a short time after, the shutter was released. The aspect of the discharge at a certain period of its duration is thus depicted on the photographic plate.

It now remains to give an account of the observations made, and to study the photographs obtained. We shall

* Kingdon's "Applied Magnetism," p. 22, 281.

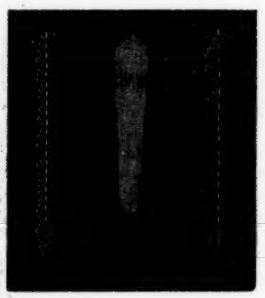
commence with the discharge in nitrogen, which is the gas in which the phenomena are best observed.

Fig. 2 is a reproduction of a photograph of the globular discharge in nitrogen, where P = 25 mm. and $p = \frac{1}{21}$ second.*

In every case the tube is vertical, and the positive electrode is at the bottom; the figures are about two-thirds the natural size, except fig. 7, which is about full size.

The duration of the phenomenon is about one second. At the moment when the discharge commences, there is seen to form at the extremity of the positive electrode, a luminosity which soon elongates, and then tapers and becomes narrow at a little distance from the electrode, and after detaching itself, takes the form represented in the figure. The luminous mass thus isolated advances towards the negative electrode with a decreasing velocity, sufficiently slow, especially towards the end, for the eye to be able to conveniently follow it and observe it. At some distance from the negative electrode the luminous mass comes to a standstill, and then suddenly disappears; this is the end of the discharge. In some cases before disappearing it retrogrades a little towards the positive electrode.

The length of the path traversed by the luminous mass depends on the pressure of the gas, and increases with it. The distance between the electrodes has no direct influence, since with a negative electrode movable along the axis of the tube, the position in which the luminous mass is extinguished is always the same, although very considerable changes are made in the position of the cathode. However, if the electrodes are brought too near, the luminous mass is not able to detach itself from the anode, and phenomenon changes its aspect by assuming the form of a progressive spark.



Globular discharge in nitrogen at 25 mm. pressure.

Fig. 2.

If the prolonged discharge is provoked, the luminous mass may remain visible from 8 to 10 seconds, and sometimes even longer. Generally after moving in the tube it remains stationary during some seconds, then retrogrades slowly towards the positive electrode, becomes larger, loses in brightness, and disappears a short distance from the latter. Since the current of the discharge at first increases in intensity, then diminishes to zero, it would appear that the movement of the luminous mass from the anode to the cathode takes place when the intensity of the current is increasing, the stoppage of the mass when the current is constant, and the retrogression of the mass when the current is decreasing.

While the prolonged discharge lasts, the connections of the coatings of the condenser, with the rest of the apparatus, may be several times reversed. Several different luminous masses may then be observed darting successively from one or the other of the two electrodes of the tube.

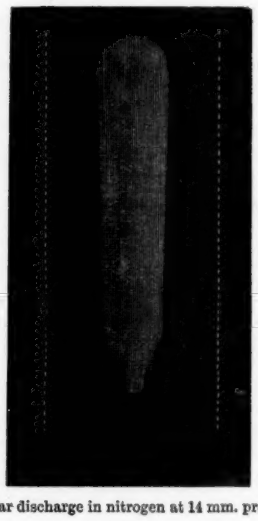
Fig. 3 (P = 14 mm., $p = \frac{1}{2}$ s) shows how the luminous mass augments in volume, and diminishes in brightness when the pressure of the nitrogen is decreased. The change of the luminous mass with the pressure has been studied in one of Righi's preceding memoirs.

* P is the pressure of the gas in the tube, and p the approximate duration of the exposure. When this is about one-half second ($p = \frac{1}{2}$ s), a pneumatic shutter is used. The values of the liquid resistance and of the explosive distance, d, are not given, because one of these magnitudes may be varied within wide limits when the other is correspondingly modified, without changing the appearance of the discharge. In general, they were arranged so as to obtain in the tube a simple globular discharge. The two dotted lines on each figure indicate the size of the discharge tube.

In these memoirs, and especially in the third, the influence of the dimensions of the tube upon the phenomena which are produced in it, have also been studied. In his recent researches he has observed that the form of the tube has a more marked influence than its dimensions. A tube much narrower, but also much shorter than that which was usually employed, exhibited phenomena on the whole similar, since there was produced a luminous mass of the form represented in figs. 2 and 3, but it was smaller, and much more luminous. Among the tubes experimented with was one of which the diameter was 1·5 cm., and of which the distance between the electrodes was 5·2 cm., which gave a small and very brilliant luminous mass. It contained nitrogen at a pressure of 27 mm. On the other hand, a tube much wider and longer than ordinary gave a luminous mass characterised by a slow movement, which was much larger and paler than in the tubes of ordinary dimensions. The pressure of the gas ought to vary inversely as the dimensions of the tube.

As a general rule, in tubes very long in relation to their diameter, the discharge tends to become composite. It is for this reason that a tube 110 cm. long, and 6 cm. in diameter, containing nitrogen at 12 mm. pressure, gives generally two or three luminous masses equidistant, and moving together. On the other hand, in wide and short tubes the luminous mass is never able to detach itself from the electrode.

When the connections are reversed, *i.e.*, when the arrangement, T, A, S, is substituted for the arrangement, S, A, T, the luminous masses move a little more rapidly, but remain a



Globular discharge in nitrogen at 14 mm. pressure.

Fig. 3.

longer time immovable before disappearing. Moreover, the composite discharge is more easily obtained in this case, *i.e.*, for a given resistance of the circuit, a shorter exciting spark is necessary. Thus it may happen that, though the discharge is simple with the arrangement, S, A, T, it may consist of two successive luminous masses with the arrangement, T, A, S.

If instead of letting the condenser discharge itself spontaneously, a prolonged discharge is provoked, then if the potential was sufficiently high before the circuit was closed, a composite discharge is still formed. As soon as the circuit is closed, two or three luminous masses present themselves one after the other, and come to a standstill at equi-distant points in the tube. When the discharge is about to stop, they retrograde slowly towards the positive electrode, and, close to it, disappear one after the other. It happens frequently that at the instant when one of the masses is extinguished the one following it stops for an instant or jumps briskly.

By placing the discharge tube in a heating bath of oil of vaseline, or a cooling bath, it has been ascertained that, other things being equal, the number of luminous masses constituting the discharge increases with the temperature. Thus, if the experiment is arranged to give a single globular discharge at a temperature of 22°, two luminous masses are formed when the temperature is 45°, and three when the

temperature is 65°. When the temperature is brought back to the atmospheric temperature, the single discharge is again obtained, and the same cycle may be repeated any number of times. This fact ought to be taken account of in discussing the probable explanation of the globular discharge.

As has been already stated, it is in nitrogen that the globular discharge is best produced, because the luminous mass is very brilliant, and moves slowly. Many other gases have been studied by Righi, and he divides them into the following classes: those in which the globular discharge is easily produced, and has a slow speed, those in which it is formed with difficulty, and, finally, those in which it cannot be produced at all.

Immediately after nitrogen, which stands in the first rank, must be placed carbonic oxide. In this gas, the luminous gas differs only in being somewhat less bright, in being green rather than red, and in having a somewhat less elongated form and a rather more rapid movement. In every other respect it behaves the same. It is a curious coincidence that the molecular weight of carbonic oxide is almost the same as that of nitrogen. Perhaps a complete theory of the globular discharge will be able to account for this coincidence.

In the case of hydrogen, the luminous mass is azure-white, very pale, of very elongated form, and moves much more rapidly than in the case of nitrogen. The period of immobility, however, which precedes disappearance, is relatively long. It appears then most frequently as a progressive spark, *i.e.*, as a luminous mass, which extends itself from the positive electrode, and the tube must be long enough in proportion to its diameter to allow the luminous mass to separate itself from the positive electrode. By reason of its great speed it is necessary to use the revolving mirror to identify it as a globular discharge, but the mirror requires to be turned only at about one turn per second or less.

In ethylene the phenomenon is much the same as in hydrogen; so also in methane, and in illuminating gas; in the last, however, the luminous masses are more brilliant.

Next come carbonic acid gas, chlorine, and ammonia, in which the discharge has the appearance of an ordinary spark. In the case of the chlorine this is surrounded with a broad yellow aureole filling up nearly the whole tube, and exciting lively fluorescence of the glass. Observed with the naked eye, this discharge looks like an ordinary spark, but when observed in a rapidly revolving mirror, it is seen to consist of a luminous mass, travelling with great rapidity from the positive towards the negative pole. Generally before becoming extinguished, this luminous mass retrogrades towards the positive electrode, and in this retrograde movement its speed is much less than in the direct movement.

With other gases or vapours no trace of the luminous mass in movement has been detected. Among those which have been tested are oxygen, sulphurous acid, cyanogen, sulphuretted hydrogen, ethyl chloride, ethyl acetate, acetic acid, sulphide of carbon, ethyl iodide, ethyl bromide, acetone, bromine, acetylene, toluene, dioxide of nitrogen, tetrachloride of carbon, trichloride of phosphorous.

With the two last vapours no discharge could be obtained, because the potential required to send it through the tube alone was greater than Righi had at command.

When using the other gases mentioned above, Righi has been able to obtain, up to the present, only flash, tuft or band discharges, or the ordinary spark, according to the pressure or other circumstances; a luminous mass in movement has never been observed, even with the revolving mirror.

Curious characteristics and peculiar effects have been observed, which are of all the more interest from being sometimes accompanied by chemical changes, which produce a gradual and continuous change in the aspect of the discharge. In the case of sulphuretted hydrogen, for instance, when the pressure lies between 10 and 50 mm., sparks of an extremely brilliant azure blue are produced in the gas. In the vapour of sulphide of carbon the sparks are greenish, and very vivid, and a blackish substance deposits itself on the glass. At the moment when the spark ceases, a helical luminous band, having a movement of rotation about its axis, remains for some instants in the tube. In the vapour of ethyl iodide, at a pressure of 10 mm., the sparks are azure and excite phosphorescence in the glass. If some nitrogen is allowed to enter the tube, a brown band is seen immediately to deposit itself on the glass. In the vapour of bromine at the pressure of 10 mm., each spark is rose coloured at the commencement, and has a white violet tinge when it finishes. The light upon the cathode is azure green, and the fluorescence of the glass is very vivid. At a pressure a little greater (15 mm.) a magnificent spark, surrounded by a broad yellow aureole, accompanied by a green fluorescence of the glass, is obtained. In the dioxide of nitrogen the spark is first orange yellow and then reddish.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.

ON RAILWAY TELEGRAPHS, WITH SPECIAL REFERENCE TO RECENT IMPROVEMENTS. By W. LANGDON, member. (Paper read April 30th, 1896.)

THE subject with which this paper deals is one which has not, for some time, claimed the consideration of members of this Institution. The progress which has attended the application of electricity to railway telegraph work is in no way comparable with that which has in recent years marked its progress in relation to lighting and power. Such advances as have been achieved are to be found more in minor details than in any radical change. Probably the most noticeable fact presides in the greater freedom from serious breaksdown which we now enjoy, and in the growth of the telegraph service—a striking testimony of its increasing utility. Competition is a stern and exacting master. The train service of to-day must not only be well-equipped, but it must work well to time. That which yesterday was thought ample, is to-day found wanting. Each day ushers in fresh demands, greater elaboration, greater exactitude! How useful a factor the telegraph becomes in enabling this to be accomplished is probably known only to those in whose hands rests the responsibility of that which has to be done.

In the year 1880,* the late Mr. Edward Graves, one of our Past-Presidents, and for many years our honorary treasurer, brought under the notice of members some extremely interesting statistics in relation to the progress of telegraphy, in which he produced a comparison between the mileage of wire and the number of instruments in use on the various railways in Great Britain in 1869 and 1879.

By the courtesy of the controlling officers of practically the entire railway service of the country—to whom my acknowledgments are gratefully tendered—I am, with the exception of the data of some two or three of the minor companies, enabled to bring forward this information another decade and a half. Accepting Mr. Graves's figures as a basis, and making allowance for the expansion of those systems the returns for which are not to hand, we get the following approximate results:—

		Miles.	Increase.
Mileage of wire employed for railway purposes.	1869	27,204	...
	1879	62,099	34,895
	1889	84,423	22,324
	1894	99,296	14,873
		Instruments.	Increase.
Number of instruments employed for railway purposes.	1869	10,121	...
	1879	46,847	36,726
	1889	100,590	53,743
	1894	130,339	29,749

It will be understood that these figures are not put forward as absolutely correct; they may, however, be accepted as fairly representative, and as a very near index of the progress and increasing influence of the telegraph service.

Prior to 1870, block signalling was but sparsely employed. During the decade 1869-79 it met with general adoption, which accounts for the large increase in both instruments and wire during that period. The increase during the half-decade 1894 is, in relation to that of the preceding decade, remarkable, as indicating that the expansion is still in active operation. These figures tell their own tale of utility in the management and regulation of railway traffic; while, from the mileage of wire maintained by the railways for the Postmaster-General, amounting approximately to some 67,000 miles, it may be reasonably inferred that the railways are in no small degree contributing to the convenience of that branch of the public who, from day to day, seek the service of the Post Office wires. Let us pause but a moment to consider how the present enormous traffic of our railways, or the mass of matter which daily passes over the various telegraph services of the country, could possibly be dealt with without these aids, or how the conditions of commercial life would be affected by their cessation, and we at once become sensible of their value.

Individually, possibly few railways afford a more forcible illustration of the rapid growth of a railway telegraph service than that to which the author is attached. In 1878 the total mileage of wire on the line amounted to 9,816 miles, and the number of instruments to 7,702. The mileage of wire to-day exceeds 22,000, and the number of instruments closely approximates to 19,000.

This large expansion is naturally calling for increasing accommodation for wires, and, in the interest of economy, for a careful study of the cost in both construction and maintenance.

* Vol. ix., p. 249.

Poles.

One of the chief factors to which we are indebted for the greater stability of our lines of telegraph at the present time is the employment of poles which have been charged to a certain extent with creosote.

In the session of 1873-74, a paper* "On the Preservation of Telegraph Poles," was read before this Institution, then the Society of Telegraph Engineers, in which the various processes for the preservation of timber were discussed. Of the several methods there referred to, the creosoting process may be regarded as the sole survivor.

Creosoted poles are now almost universally employed. Their life, or the period they may remain in position without deterioration from decay, is still, to all intents and purposes, undetermined. Given a properly seasoned pole, fairly dry when placed under the process, its life may reasonably be relied upon to cover the period the pole is required to stand before additions or alterations call for its replacement.

It is neither necessary nor desirable that the timber of telegraph poles should be completely charged with creosote. The quantity of creosote impressed into telegraph poles is usually 8 lbs. to the cube foot of timber; and this quantity, where the wood is properly seasoned and well dried, will be found to have penetrated to the core or heart-wood of the pole. It will thus form a complete protective shell, impervious to moisture, and in this lies the main advantage of the application.

Timber which is thoroughly impregnated or saturated with creosote becomes, as soon as the oil is dissipated, devoid of much of its elasticity, and is then more easily broken than if the heart-wood of the timber is allowed to remain uncreosoted.

There are points where creosoted poles are objectionable—such, for instance, as station platforms. Here, whereas in former years Memel timber was usually employed, it is preferable to use pitch pine. Pitch pine is more durable than Memel. It is more resinous, and thus more antagonistic to the reception of moisture; and it is the moisture which, traversing the fibre of that portion of the timber in the soil, under the influence of the warmer atmosphere above the ground line, disintegrates it at, or about, the ground level, and so destroys it.

The number of wires which have now to be accommodated, in many instances, call, not merely for stout poles, but for structures

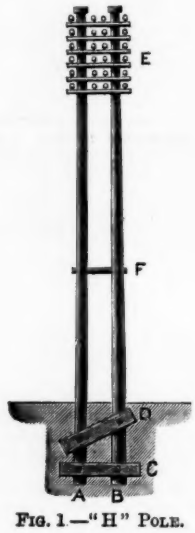


Fig. 1.—"H" Pole.

such as "H" poles. These structures (fig. 1) consists of two poles, A, B, braced together at the foot by a slab of wood, C, as nearly as possible at right angles to the poles, and a further slab, D, some 4 feet from the butt end of the poles, arranged diagonally; the arms, E, at the top of the poles act as the tie-pieces at that end of the structure. These are sometimes, especially in high poles, supplemented by a stiff iron rod, F, passing through the two poles at right angles to them, or by rods crossing one another diagonally, tied together in the centre.

The practice has been to allow the two poles forming the basis of this structure to have a slight spread at their butt ends; *i.e.*, taking a centre line down the poles, the distance between these lines at the top of the poles being some 12 inches less than that between the centre lines at their butt ends.

When poles become crowded with wires, this, with respect to the lower arms, detracts from the regularity of the insulators and wires. It is better that the poles should be equi-distant throughout. You have then merely to provide for the increasing thickness of the timber in order to ensure perfect regularity in the position of the wires from top to bottom.

The Midland Railway having recently been called upon to construct for the Postmaster-General a section of an important trunk line to Scotland, it has been necessary to convert an existing line of single poles into an H line. To construct these H poles, braced together at the foot, as shown in fig. 1, would have meant the replacement of the entire line—a most expensive operation. Under these circumstances the existing line of poles has been allowed to stand. At the proper distance a pole, B (fig. 2), to match the standing pole, A, has been placed in position, care being taken to cut off the butt end so as to ensure a flat basis. It has then been allowed to stand some days, so as to become well settled in its position, after which slots for the arms are cut to correspond with those on the original pole. The short arms are then, one by one, removed from the latter, and replaced by arms 56 inches long, which are bolted to the two poles. Where the old line of poles has been systematically constructed, with the arms, say, 12 inches apart, centre to centre, the appearance of such a combination is in every way agreeable to the eye.

It will be evident that without the diagonal tie-piece the poles might, under stress of wind, work themselves out of position. This has to be met by staying them in the same manner as a single line. Where, from exceptional causes, the poles cannot be stayed, the diagonal tie-piece should be employed.

H poles are destined to be of great service. There is no reason why the number of wires should be limited to four on an arm. The

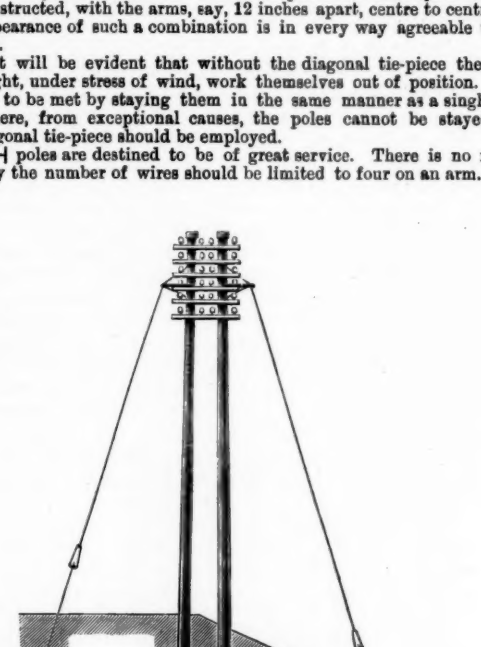


Fig. 2.

56-inch arm may be replaced by a 72-inch arm, accommodating six wires, thereby increasing the capacity of the poles one-third. We may even venture beyond this where the need for it exists, employing either iron arms or wooden arms of larger scantling, in order to meet the weight of the wires standing on the outer side of the poles. The structure is one which, if well stayed, will withstand gales far better than single poles with half the number of wires, arranged two on an arm.

Moreover, it will be observed that H-poles, with six wires on an arm, lend themselves to telephone requirements. With the wires arranged two outside each pole, and two between the poles, three groups, or squares, may be formed by each pair of arms—each wire of each "square," or "group," being maintained 1 foot apart.

Telegraph poles seldom commend themselves to the observer as an æsthetical subject; but uniformity in construction, with the poles well in line, or regularly following the contour of the road, evenly graduated for height, and uniformly armed and wired, with, perhaps, an ornamental top in exceptional places, will do much towards removing those objections which are not unfrequently raised against their presence.

Arms.

In the trimming of poles, the most novel feature is the introduction of iron arms.

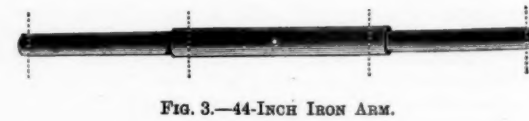


Fig. 3.—44-Inch Iron Arm.

Forty-four inch tubular iron arms, specimens of which are before the meeting, have been employed for some 100 miles of the trunk telephone line recently erected by the Midland for the Postmaster-General. Some years prior to this shorter arms—tubular and rectangular, for carrying two wires—were experimentally employed

* *Journal Institution Electrical Engineers*, Vol. iii., p. 181.

by the author. No inconvenience whatever has, so far, attended their employment.

The longer (44-inch) arm (fig. 3) is composed of 1¾-inch galvanised iron tubing, ⅛th inch thick, strengthened by a piece of larger gauge tubing, of same thickness, 2 inches in diameter, carried over the centre portion of the 1¾-inch tubing. The two tubes thus combined are practically homogeneous and very strong.

The employment of these arms admits of a slight reduction in the length of the insulator bolt, which may, with advantage, have the shoulder of the bolt, as also the washer, hollowed out to fit the arm. Thus arranged, there is no possibility of the insulator twisting round. These arms should be very durable, and it is worthy of remark that they do not require so much of the pole cut away as is necessary for the wooden arm.

The earth-wiring of wooden arms has, the author believes, in some quarters, been abandoned. That course has not been pursued on the Midland. Earth-wiring, as illustrated by the sample placed upon the table, is still followed. With iron arms, the need for earth-wiring disappears. It is merely necessary to lay the main earth wire securely under the washer of the arm bolt.

Clearly, where iron arms are employed, failure in insulation, such as that produced by a broken or cracked insulator, will readily make itself known. To what extent this will operate with respect to the iron arms experience must show. In a trunk telephone line discrepancies in the insulation of the four wires forming a square would appear to be undesirable factors. Whether such failure may be more readily traced with iron than with wooden arms has yet to be proved. The iron arms ought, where "earth" is the cause of failure, to give a more defined fault, and thus lead to its more ready removal. Iron arms and brackets, as well as iron poles, have, in various forms, been in use for years, especially for foreign lines; and probably no member of the Institution has a more intimate knowledge of their value than our Past-President, Mr. Alexander Siemens.

In slotting round poles for these iron arms, it was at first thought that a V-shaped cut would readily lend itself to the reception of the arm; but experience has shown that it is better to slightly slot the pole, as though for a rectangular arm, and gouge out the base of the slot. The pole being round, the V-shaped cut fails to retain the arm in that rectangular position, in relation to the pole, which is necessary to give the line that trim and uniform appearance so acceptable to a good workman.

In the employment of wooden arms there is nothing of a novel character to record. They are to-day very much as they have been during the last 20 years. It may not, however, be inopportune to raise the question whether English oak is the only timber from which they should be made. Doubtless English oak is more durable and stronger than other timber; but it is a question whether foreign oak—say Stettin—if cut under the conditions applicable to English oak, viz., well seasoned, free from knots, and free from sap, is not sufficiently durable and strong for the purpose. Arms cut from this description of timber have been in use on the Midland system for many years, and nothing has transpired to create a want of confidence in its suitability for such work.

Another point worth considering is that of painting the arms. Paint, if applied when then the timber is properly seasoned and dry, is, no doubt, beneficial; but paint applied to wood which does not possess these qualifications produces dry rot, and is, consequently, absolutely injurious to the timber, and dangerous to workmen when on the poles. Where the arms can be stacked by the user until thoroughly seasoned, they may with advantage be painted.

Staying.

It is no exaggeration to say that to the more perfect manner of staying the telegraph lines of the present day, and to the employment of machine-stranded staying wire, are we indebted for that greater immunity from heavy breaksdown which we enjoy at the present time. It is, in cases of snow falling under those conditions which cause it to cling to the wires, a question of strength of pole *versus* strength of wire. Needless to say, it is preferable that the wires, rather than the poles, should suffer; and, as a rule, such is the *status* at which well-built telegraph lines of the present day have arrived.

On railways there is usually more room for staying poles than is the case on roads. The greater the spread of the stay the greater its advantage. In order to be of the greatest service its attachment to the pole should be somewhat above the centre of the full complement of wires which the pole is designed to carry. It is seldom, however, one can determine the number of wires which a line shall ultimately support, and thus it is well to fix that point which may be most serviceable under any condition. The practice pursued by the author has been to fix the upper stay between the third and fourth arm, and where a second stay is required—as is frequently the case with heavily wired lines—between the eighth and ninth.

Formerly the practice was to form the stay on the pole, wire by wire. A single wire was first attached to the pole and strained up tightly to the stay-rod; then a second wire was attached and strained up, as nearly as could be judged, to the same degree of tension, and so on, till the necessary strength was attained. The objection to such stays is the absolute improbability of so arranging the several wires of which the stay is composed, that each shall bear its share of the strain. As a rule, the strain falls upon one wire more than another. Under great stress, this wire is the first to give way. The rest follow in like manner.

With machine-stranded staying wire, each wire bears its own proportion. If properly stranded—*i.e.*, with a long lay—it is easily handled. When attached to the stay-rod it should be passed around a pear-shaped eyelet. To Mr. W. H. Preece, C.B., F.R.S., Past-President, we are indebted for the introduction of machine-stranded wire for this purpose. Staying wire should be of a steely character. The Midland specification provides that each No. 8 gauge wire (which is the only gauge used for stranded staying wire) shall stand a strain of 1,800 lbs., with a maximum stretch of 4 per cent., without breaking, and that it shall bear 12 twists in a length of 6 inches without fracture and without scaling.

An excellent device for binding stranded stay-wire has recently been introduced by Mr. Roberts, of the Postal Telegraph Department, which enables the workman to accomplish his task well and with ease. The tool itself will be found upon the table.

The strand wire is first bent so as to form the loop around the stay thimble, A (fig. 4), the splicing tool, B, being employed to draw it closely into the groove. The free end of the stay wire is then unstranded, and the wires straightened out, as shown at C. One wire, D, is picked out for the purpose of forming the first lap of the binding; the tool is then employed to arrange the remaining wires symmetrically parallel with and around the main strand, so that they may bind into it without spoiling its circular shape. The free wire is now placed under the hook of the stay tool, which is revolved around the stay and the remainder of the wires. When the first selected wire has been used up, another is chosen, and the same course followed with each, until all have been evenly bound around the main stay.

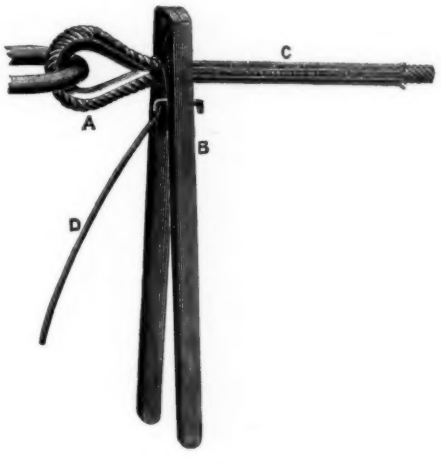


Fig. 4.

All stay-rods planted in soil formed of cinders or ashes should be protected by fillets of creosoted wood, or they will rapidly succumb to the electrolytical action set up by the ashes and the galvanised iron. On railways it frequently happens that the top ballast is composed entirely of refuse cinders or ashes.

(To be concluded.)

The Société Internationale des Electriciens.

The annual general meeting of the Société Internationale des Electriciens took place April 1st, 1896, with the Vice-President, M. R. V. Picou, in the chair. After the presentation of claims for admission, the treasurer gave an account of their financial position, and then the general secretary read the report of the committee of accounts. Lastly, the chairman read the report of the session 1895, drawn up by M. Potier, the retiring president. The next proceedings were the voting for the partial renewal of the Bureau and the Committee, and the nomination of the Committee of Accounts.

Technical communications were then proceeded with during the reconstruction of the list. First, M. Branly read a paper on "The Resistances of Metals to Contact when the Pressure is Varied." He gave a series of results, and spoke of the methods he had used, but did not greatly interest his audience.

M. P. Janet, Director of the Central Laboratory of Electricity, then described the standardising of a voltmeter of 20,000 volts, this standardising having been effected at the Laboratory. This voltmeter is a Lord Kelvin electrometer graduated directly up to 20,000 volts, and belonging to the Société Industrielle des Telephones. It is an ordinary electrometer with two quadrants only, with an aluminium needle bearing two perpendicular axes, on which aluminium screws may be placed, in order to make the axis of suspension coincide with the centre of gravity. Small weights of special shape, and made to hook one into another, effect the regulation. Weights of 28, 34, and 336 milligrammes enable three degrees of sensitiveness to be attained in the ratio of 100, 200, and 400 volts.

M. Janet stated that, for standardising, he had thought of employing a transformer with a known ratio of transformation. It was necessary to assume that the ohmic loss was nil, and that there were no internal magnetic losses. He preferred to use the direct method of comparison with Messrs. Abraham and Lemoine's absolute balance electrometer. He showed his audience the curves obtained for gra-

duations from 0 to 4,500, from 4,500 to 9,000, and from 9,000 to 18,000 volts. With the exception of the first division, in which the curve shows a slight convexity, the curves of graduation are to all intents proportionate.

At the end of the sitting the President read the results of the voting. The following elections were made:—President for 1897-1898, Dr. d'Arsonval. Vice-presidents: Messrs. De Neruille, Pellat, E. Sartiaux. Secretaries: Messrs. Gosselin, J. Laffargue, L. Poincaré. Treasurer, M. Violet. Members: Messrs. Baudot, L. Brillié, Cance, Curie, Dujardin, Fayot, Grosselin, E. Hospitalier, Miet, Mildé Ch., Minet, Monmerqué, Montpellier, Picou, Raffard, Richard, Street, Vaschy, Voisenat. Committee of Accounts: Messrs. Armengaud, Berthon, G. Masson.

M. Picou then resigned in favour of M. Sciama, who was elected President for the season 1896-1897. The latter deferred until the next meeting the usual speech, and closed the sitting.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co. *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

NEW PATENTS.—1896.

8,262. "Apparatus for fastening and tightening wires for electric streams to insulators by means of a lever." M. Commichau. Dated April 20th.

8,269. "An improved system of running and insulating concentric electrical conductors and appliances in connection therewith." G. Wilkinson. Dated April 20th.

8,271. "Improvements in or relating to electric traction." W. S. Boult. Dated April 20th.

8,308. "Improvements in or connected with electrical resistances." V. A. Fynn. Dated April 20th.

8,316. "Improvements in electric switches." E. H. Wright J. J. Heckman, A. H. Graves, C. C. Carnahan, and W. H' Carnahan. Dated April 21st.

8,320. "Support or bearing for electrical accumulators or other apparatus, having for its object the minimising of vibration." G. Fabbro. Dated April 21st.

8,323. "A new or improved process of electrically treating fabrics for waterproofing and other purposes." C. M. White. (The Electro-Waterproofing and Dye-Fing Company, United States.) Dated April 21st.

8,362. "Improvements in and relating to electric signalling devices between cars of railway trains." E. J. Devine. Dated April 21st.

8,380. "Improvements in printing telegraph instruments." B. F. Merritt and J. M. Joy. Dated April 21st.

8,382. "Improvements in automatic circuit breakers for use in electric tramcars or other electrically propelled vehicles." J. Devonshire. (W. B. Potter, United States.) Dated April 21st.

8,397. "Improvements in electrical cut-outs." H. Edmunds. Dated April 21st.

8,398. "Improvements in or connected with electrical resistances." H. Edmunds. Dated April 21st.

8,399. "Improvements in apparatus for completing, interrupting, and controlling electrical circuits." H. Edmunds. Dated April 21st.

8,410. "Improvements in the electro-deposition of metals, particularly applicable to the deposition on wires." J. C. Graham. Dated April 21st.

8,458. "Improvements in electrical recording instruments." W. Turvey. Dated April 22nd.

8,483. "An improvement in joints for electrical cables." Siemens Bros. & Co., Ltd., and W. Dieselhorst. Dated April 22nd.

8,507. "Improvements in chandeliers, gaseliers, electroliers, and other hanging lamps." J. Hinks & Sons, Ltd., and F. R. Baker. Dated April 22nd.

8,512. "Improvements in or connected with drain pipes, water, or electric conduits, and the like." G. W. Dolman. Dated April 22nd.

8,514. "Improvements in electric glow lamps." I. A. Timmis. Dated April 22nd.

8,541. "Improvements in electric lamps for miners and in the method of lighting said electric lamps." W. Woodhead. Dated April 23rd.

8,569. "Improvements in apparatus for making electrical contact by passage of a railway train." E. Tyer. Dated April 23rd.

8,647. "Improvements in induction electrical machines." F. Tudsbury. Dated April 24th.

8,659. "Improvements in paste-carrying plates for electric accumulators." F. W. Schneider. Dated April 24th.

8,660. "Improvements in the construction of cells for electric accumulators." F. W. Schneider. Dated April 24th.

8,666. "Improvements in and connected with battery electrodes." The Battery and Motor Company, Ltd., and H. T. Barnett. Dated April 24th.

8,682. "Improvements in hand grenades and in electrical firing apparatus applicable for firing the same." C. A. McEvoy. Dated April 24th.

8,695. "Improvements in electrodes for accumulators." W. Majert. Dated April 24th.

8,743. "Improvements in speaking tube, telephone, and the like receivers." H. A. Cutmore. Dated April 25th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps.*)]

1895.

7,315. "Improvements in and connected with electrical storage batteries." W. J. S. Babber-Starkey. Dated April 10th, 1895. Relates to an improved battery plate formed of discs, not necessarily circular in plan, threaded on a core of lead. The discs are radially corrugated, or are provided with fangs or projections so that cavities are formed between the discs in which the active material is placed. 4 claims.

14,262. "An improved indicating and signalling apparatus." T. Karn and J. T. Payne. Dated July 26th, 1895. The signalling apparatus consists of a dial, a clock dial for example, with pointers arranged to be turned by a handle from a zero position to the position desired. The rotation of the pointer makes and breaks a circuit at predetermined intervals and operates the receiving mechanism through an electro-magnetic step by step motion actuating a pointer which ultimately takes up the same position as the signalling pointer. 4 claims.

19,860. "Improvements in and relating to regulating electric motors in three-wire systems of electric railways." J. Devonshire. (W. B. Potter, U.S.A.) Dated October 22nd, 1895. The rails or earth return wire is made the neutral or third wire of the system and two pairs of motors are provided upon each car, one pair being joined by a trolley to the first wire and the other pair being joined by a second trolley to the second wire of the systems. The two pairs of motors are simultaneously controlled by two controllers geared together. By this means the load on either side of the neutral wire is maintained practically equal and very little current will flow by way of the rails or earth. When the system is changed to a single trolley system (in towns for example), the four motors on each car are connected in series. 13 claims.

22,574. "Improvements in the manufacture of insulating compositions for electrical purposes." C. J. Grist. Dated November 26th, 1895. The insulation is composed of a fibrous substance such as jute, &c., well dried and dipped three times in a mixture of boiled linseed oil and litharge. Between each dipping the oil adhering to the fibres is oxidised and dried by hot air. The fibres are worked to a homogeneous mass in grinding rolls, 15 per cent. or 20 per cent. of sulphur is added, and the mixture incorporated by passing through crushing rolls. 5 per cent. to 25 per cent. of gutta percha, wax or the like is then added and the material is rolled into sheets for storage. It can be applied in any suitable manner to wire or for other purposes. The compound may be vulcanised if desired. 2 claims.

22,936. "Improvements in and connected with electrical commutators and collector rings and collectors therefor." F. T. J. Trauss. November 30th, 1895. Instead of copper or carbon collecting brushes mercury is used. The commutators are arranged so that the places where the current is to be collected at different points along the axis instead of at opposite ends of a diameter of the commutator. 8 claims.

24,172. "Improvements in or connected with galvanic batteries." A. C. Ivanowski. Dated December 17th, 1895. A constant current is obtained from a battery of cells by arranging that as the current diminishes owing to polarisation, the electrolyte shall be caused to rise in the cells so as to act upon a fresh part of the surface of the electrode. 4 claims.

EXPIRING PATENTS.

We are informed by Messrs. W. P. Thompson & Co., that 70 applications for patents of electrical inventions were filed in the month of May, 1882. Of these, several were never completed, and of those that were completed not one has been maintained to run its full term of 14 years. Two patents ran for 13 years, expiring last May, all the others were abandoned after the lapse of a few years.